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(TBD AMC)

Contractor Report (TBD AMC)

HOWITZER AMMUNITION SYSTEM PROCUREMENT (HASP)

E.L. Johnson
Alliant Techsystems Inc.
5901 Lincoln Drive
Edina, MN 55436



July 1991



US ARMY
ARMAMENT MUNITIONS
& CHEMICAL COMMAND
ARMAMENT RDE CENTER

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

U.S. Army Material Command

Alexandria, Virginia

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS N/A		
2a. SECURITY CLASSIFICATION AUTHORITY N/A			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release, distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) N/A			5. MONITORING ORGANIZATION REPORT NUMBER(S) Contractor Report Number (TBD AMC)		
6a. NAME OF PERFORMING ORGANIZATION Alliant Techsystems Inc.		6b. OFFICE SYMBOL (If applicable) ATK	7a. NAME OF MONITORING ORGANIZATION AMSMC-PCW-B (D)		
6c. ADDRESS (City, State, and ZIP Code) 5901 Lincoln Drive Edina, MN 55436			7b. ADDRESS (City, State, and ZIP Code) U.S. Army, AMCCOM Picatinny Arsenal, NJ 07886-5000		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AMC, Production Base Readiness Branch		8b. OFFICE SYMBOL (If applicable) AMCP-PBA	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DAAA21-90-C-0123		
8c. ADDRESS (City, State, and ZIP Code) Alexandria, VA 22333			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
11. TITLE (Include Security Classification) Howitzer Ammunition System Procurement (HASP)					
12. PERSONAL AUTHOR(S) Larry Blagdon, Mark Conrad, Ken Fraasch, Warren Hawkins, Robert Olsen, Duane Oyen, Robert Specht, Martin Virshek, Bruce Whitehead					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 1990 TO 1991		14. DATE OF REPORT (Year, Month, Day) 1991 July	
15. PAGE COUNT TBD					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Systems	Procurement	Cost
			Howitzer	Readiness	Budget
			Ammunition	Quality	Breakout
					Component Breakout
					Systems Contracting
					Make/Buy Management
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>The Howitzer Ammunition System Procurement (HASP) study documents the potential benefits that industry systems management offers to the U.S. Army and U.S. Government. Three major areas are covered:</p> <ol style="list-style-type: none"> 1. Howitzer ammunition base readiness 2. Total system cost and schedule 3. Total Quality Management (TQM). <p>For each area, the contractor examined existing government and industry data, records and report findings to determine which procurement options were most viable in enhancing the ammunition base readiness, reducing total system cost, and improving TQM implementation on future howitzer ammunition programs. The contractor then compiled a set of conclusions and recommendations for implementing industry systems contracting on a more widespread basis.</p>					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL Mrs. M. Doyle			22b. TELEPHONE (Include Area Code) 201-724-2002		22c. OFFICE SYMBOL AMSMC-PCB-BC(D)

UNCLASSIFIED

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SECTION 1 EXECUTIVE SUMMARY

The Howitzer Ammunition Systems Procurement (HASP) study was conducted to discover and describe the advantages to the U.S. Government of industry systems management. In conjunction with the study, a government/industry survey was prepared and taken cooperatively with the American Defense Preparedness Association (ADPA) and independently conducted by a professional survey company, Questar Data Systems. The purpose of the survey was to explore and examine government and industry opinions regarding ammunition systems procurement. The study and survey were accomplished under contract DAAA21-90-C-0123 to the U.S. Army Armament, Munitions and Chemical Command at Picatinny Arsenal, New Jersey.

Study Findings

The research and detailed analysis of the HASP subject matter reveal that systems contracting for ammunition from industry is a growing world-wide trend. In addition, systems procurement of ammunition:

- Is compatible with all applicable laws and regulations
- Is compatible with mobilization and readiness needs
- Increases visibility and accountability of costs
- Increases industry willingness to invest in the ammunition business
- Decreases government risk, life cycle costs, and total time required for development and production
- Is essential for increased foreign sales of U.S. ammunition, and international competitiveness of the U.S. mobilization base.

The study concludes that the key to future ammunition procurements is a strong government and industry partnership directed toward mutual objectives. While government functions as the "smart buyer," managing the big picture and its technical base, industry helps prepare and executes the plan. Most often, the logical "system" definition is the unit level at which a howitzer ammunition item is budgeted and inventoried. Table 1-1 summarizes the recommendations and benefits rationale for the HASP study (reference Section 5).

Study Background

The HASP study background (reference Section 2) consists of the legal and regulatory environment, the history and evolution of acquisition strategies and practices, and the global, domestic, and DoD budget trends which affect ammunition. Our examination of background issues indicates that:

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Table 1-1. Howitzer Ammunition Systems Procurement (HASP) Study — recommendations

Recommendation	Applicable Drivers	Benefits
Make mobilization readiness the primary goal of ammunition procurement.	Mobilization base, foreign sales.	Maximizes support for troop top priority mission.
Make ammunition awards on a "best value" basis.	Acquisition environment, product management, cost, TQM.	Minimizes total cost, prevents
Procure howitzer ammunition (and other ammunition) at the round level and delegate all relevant functions to industry systems contractors.	Cost, mobilization base.	Conforms to established U.S. government workload, increases reduces total cost over life of
Procure howitzer ammunition at the round level to improve quality at the round level.	TQM.	Improves quality, readiness and assurance, and reduces long-
Encourage industry investment through long term relationships with committed ammunition systems contractors.	Mobilization base, TQM, investment, product improvement.	Builds partnership with Government technology and quality improvement ammunition.
Encourage industry marketing of foreign ammunition sales through systems contracting.	Mobilization base, foreign sales.	Provides warm base for U.S. GOCO workload, (increases position internationally.)
Tailor acquisition strategy to the particular system and the new environment.	Acquisition environment.	Maximizes flexibility of acquisition within Government.
Use industry systems contracting to reduce number of government procurement actions.	Acquisition environment, U.S. budget.	Minimizes government workload
Revise breakout pricing models to reflect true costs of production for FMS pricing and DoD budget requests.	Total cost, foreign sales.	Encourages industry marketing government/industry management decisions.
Use system prime contractors to improve meeting total dollar SB/SDB goals.	Acquisition environment.	Strengthens SB base.
Use industry systems management to accomplish transition to production and schedule optimization.	Schedule, TQM, product management.	Reduces risk, improves schedule focuses developer attention on
Continue implementation of system-level warranties.	TQM, cost	Improves quality, reduces cost readiness and reliability assurance
Institute systems contractor certification program as soon as possible.	TQM, schedule.	Focuses attention on quality and performance. Prevents buy-in
Involve systems contractors early in product life, and incentivize them to make product improvements.	U.S. budget, technology base, schedule, investment.	Stimulates investment by increasing long-term strategic planning.
Use systems contracting for future systems R&D needs.	Technology base, project management, cost, schedule.	Optimizes government's small reduces demands on future government resources.

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urement (HASP) Study -- recommendations and benefits summary

s	Benefits	Comment/Rationale
sales.	Maximizes support for troops to accomplish top priority mission.	The only reason to have any ammunition base is to supply field troops. The "readiness for troop support" priority is written into all U.S. law, including CICA.
product	Minimizes total cost, prevents buy-ins.	Universal agreement that "price only" competitions have not served the needs of the ammunition community. "Best value" is most compatible with systems contracting.
	Conforms to established U.S. policy, reduces government workload, increases accountability, reduces total cost over life of program.	Five to ten percent learning curve differential by year three for systems contracting. Industry leverages investments and focuses management on schedule, readiness planning, product improvements, and VECs.
	Improves quality, readiness and reliability assurance, and reduces long-term costs.	TQM improvements and cost savings potential are greatest in the integration, not component, phases of design and production.
	Builds partnership with Government, ensures technology and quality improvements to ammunition.	Stability is the key to industry's commitment of investments. Companies retain market share through IR&D, and provide bridge funding/advance releases maintain production continuity.
sales.	Provides warm base for U.S. to supplement GOCO workload, (increases U.S.'s competitive position internationally.)	The rest of the world competes internationally through active selling at the system (round) level. This is the only way to stimulate U.S. company interest.
	Maximizes flexibility of acquisition managers within Government.	Historic baseline was breakout with systems procurement as the exception. New environment and U.S. policy dictate reversal in favor of systems procurement. Change is fully compatible with all laws and regulations.
U.S.	Minimizes government workload.	Top level DoD-directed civilian staff cutbacks in the Army translate to greater than 20 percent decline in AMCCOM headcount.
	Encourages industry marketing, improves government/industry management practices and decisions.	Currently the cost of government management is hidden in overhead accounts. Industry/government management costs are similar, and much of industry's "profit" flows back to the Government.
	Strengthens SB base.	Mentor-Protege Subcontract Program indicates new Congressional commitment to industry SDB subcontracting versus government prime contracting and SDBs.
	Reduces risk, improves schedule management, focuses developer attention on producibility.	Shortens development to IOC schedule by over two years—through advance planning, bridge funding, and parallel activities.
	Improves quality, reduces cost, increases readiness and reliability assurance.	Warranty benefits are not visible unless invoked; however, existence of warranty provision encourages contractors to improve quality to prevent need to do rework.
	Focuses attention on quality and rewards performance. Prevents buy-ins.	Implementation issue exists over requirement to be certified versus "best value" evaluation for contract award. A requirement for certification is likely to be legally challenged.
use,	Stimulates investment by industry, allows long-term strategic planning.	Component-level contracting disincentivizes IR&D, and investment. Systems contracting promotes continuous incremental upgrades via IR&D.
..	Optimizes government's smart buyer role, reduces demands on future government resources.	Government labs focus on materials and basic research, industry focuses on weapon systems application.

- Industry systems contracting is the preferred acquisition approach, according to applicable U.S. law. This includes the Competition in Contracting Act (CICA), which specifically exempts mobilization planned items such as ammunition from its coverage.

- The decline in the U.S. defense budget (from 12 percent of the GNP in 1953 to 3.6 percent by 1996, and from 57 percent of Federal spending in 1953 to 18 percent by 1996) is severely impacting total DoD and Army ammunition spending and headcount. Ammunition budgets by 1993 will be half the level of 1986, and Army civilian employees are projected to number 37 percent fewer than in 1986. Both budgets and headcounts are trending further downward.

- Defense products in the 1990s are as subject to globalization of our economy and foreign competition as were automobiles, electronics, and steel in the 1980s, with one key difference: the decline in the non-government industrial base for ammunition not only impacts our economy, it impacts our security as a nation

- The U.S. has been gradually moving away from government production of munitions. Our closest allies have been moving away faster, privatizing production through systems contracting with industry and divestiture of government assets.

- By altering acquisition policies to encourage industry systems contracting the U.S. Army can achieve significant future foreign sales of ammunition, thereby shoring up our U.S. defense industrial base.

These facts and trends suggest that even more changes are going to occur in the size and role of the Government and in the size and makeup of the ammunition base. While the U.S. defense industry recognizes the need to preserve readiness as the first priority, the body politic and society are naturally resistant. While there is an honest diversity of opinion about the best way to maintain a viable ammunition capability, we still need to retain our focus on the primary goal of providing quality ammunition, on time, to our armed forces.

Study Methodology

During the course of the HASP study, Alliant Techsystems undertook the following:

- Formulated a methodology for analyzing key acquisition drivers
- Performed defense technology and generic literature searches
- Obtained and analyzed government ammunition procurement data where available and applicable
- Analyzed key acquisition drivers
- Conducted in-process reviews with key customers from the Army
- Contracted with an independent survey company to conduct an ammunition system procurement survey with Government and industry
- Documented conclusions and recommendations regarding howitzer ammunition procurement in this report.

We implemented a highly structured methodology (reference Section 3) to enable us to focus the study and to determine where industry systems management provided advantages to the U.S. Army. During the HASP study, we identified and analyzed the following key acquisition drivers:

- World and Budget Environment
- Acquisition Environment and Political Considerations
- Product Management, Requirements, and Improvements
- Technology Base
- Mobilization Base Readiness
- Foreign Sales Considerations
- Total Cost
- Investment
- Schedule
- Total Quality Management.

Taken together, these key drivers comprised the three areas—Readiness, Cost, and Quality—which we contracted to study in this report (reference Section 4).

Survey Findings

To determine government and industry views regarding ammunition procurement and systems contracting, a survey of the appropriate population was conducted by a professional survey firm under subcontract to Alliant Techsystems. The American Defense Preparedness Association Industry Affairs Division was a full participant and sponsor of the survey, and the respondent population list was coordinated with AMC and AMCCOM to ensure the inclusion of appropriate individuals and firms: large, small, prime, subcontractor, GOCO, Small Business, and Small Disadvantaged Business—all participants in ammunition production. A pre-survey announcement and survey follow-up reminder was used to ensure reasonable sampling. The response rate for scaled questions was just above average, and the results are considered 85 percent reliable, within a five percent margin. The survey questionnaires, summary and data trend report, and HASP analysis are included as Appendix B to this report.

The results of the survey essentially confirm the analyses of the HASP Study. For example:

1. Preferred Approach: Industry systems contracting was preferred by 83 percent of GOCO respondents, 89 percent of government respondents, and 67 percent of small business respondents.
2. Production Schedules: 100% of the GOCO respondents reported that production processes run more smoothly with plant-procured or prime-furnished material than with Government Furnished Material (GFM).
3. Cost and Quality: A large majority of respondents (69 percent Government, 93 percent Industry, and 83 percent Small Business) endorsed Quality as the primary award criterion, and rejected low cost bids (100 percent of Government respondents rejected "price-only" competitions).
4. Total Quality: A majority of all respondent groups believed that industry systems contracting is the most compatible approach with TQM implementation, though they disagree on the degree to which this has been promoted to date.
5. Readiness and Schedule: Among the large business respondent group, 64 percent invested company funds to maintain active production without contract coverage—this is a key factor to good schedule performance and schedule management.

These sample data points indicate that a majority of both the Government and industry ammunition community are prepared to embrace changes to ensure fulfilling the mission. Further details and types of questions are found in Appendix B.

Implementation Issues

Based on our analyses, conclusions, and recommendations, we identified certain policy and practice changes that AMC could implement which would remove the various obstacles to industry systems management. Specific implementation recommendations are found in Appendix A, and are summarized below:

- Adjust SB/SDB goal reporting (through SB/SDB flowdown to system primes and through Mentor-Protege programs) to accommodate industry systems contracting, while still maintaining the total dollars committed to Small and Small Disadvantaged businesses.
- Quote FMS cases to accommodate new cost accounting standards (i.e., to include all government system management costs in the FMS bids).
- Convert general-purpose LAP plants from workloaded GOCO-type contracting to basic facilities contracting arrangements.
- Adopt a common, uniform rate structure for cost accrual at GOCOs.
- Review the apparent conflict in procurement policy and practice between OMB A-76 and DFAR 217-7202.3, and draft an Army directive clarifying the conflicts and recommending industry systems contracting on future ammunition procurements.

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SECTION 2 HASP BACKGROUND

The Need

According to the *Army Focus*,

"The Army must maintain a peacetime production base for ammunition requirements capable of supporting mobilization and sustaining our forces during war."¹

Fulfillment of this vital responsibility is the mission of the Armament, Munitions, and Chemical Command (AMCCOM), which utilizes a variety of government and industry facilities. This mission has been performed well over the past fifty years by AMCCOM and its predecessors (ARRCOM, ARMCOM, MUCOM, APSA, etc). There are very few situations in U.S. military history where the troops in the field have been unable to fight effectively due to a lack of ammunition. However, given the current trend of sharp budget declines, changing threats, and globalization of the defense marketplace, the U.S. Army faces a considerable change in the way it manages ammunition acquisition.

This Howitzer Ammunition System Procurement (HASP) report examines the issue of industry systems management versus what is commonly referred to as "component breakout." The issue is approached here as a government "make or buy" decision for the tasks of systems integration and management of ammunition development and production. Due to the origin of the ammunition development and production process, the U.S. Army has historically functioned as in-house designer and producer of ammunition. This situation has been changing in the rest of the world, as other countries have altered their governments' day-to-day role away from "doer" to "smart buyer." The broadly accepted term for this de-nationalization of munitions, and other industries, and others, is "privatization." Elsewhere in the world, this "privatization" has resulted in increased industry systems management of ammunition development and production programs.

The HASP study addresses the question of whether the U.S. Army should adopt industry systems management as the preferred approach for Howitzer ammunition procurement. Due to AMC down-sizing, AMCCOM will reduce the emphasis on in-house system integration and management of ammunition development and production. Accordingly, AMCCOM will rely more heavily on industry for performing these functions, but in a manner which preserves the vital GOCO resource investments and capabilities. Given the major challenges which face AMCCOM in the areas of mobilization base readiness, ammunition affordability, and total quality, finding the best solution to these challenges is extremely important.

¹ "Ammunition," *Army Focus*, Topic Number 42, p. 55, November 1989

U.S. Federal Acquisition Policy is to Buy From Industry

The basic federal acquisition policy, as stated in OMB A-76, is to buy from industry wherever possible and practical. OMB A-76, like DFAR 217.72, assumes that the private sector provides what the DoD requires, unless one of two conditions dictates otherwise:

1. If the government cost to do the work is at least 10% less than is industry's, based on a "full cost analysis." Traditionally, the National Defense exception and the Arsenal Acts have been cited to enable consideration of only "out of pocket" costs.

2. If economic displacement would affect more than 40 Civil Service workers. Traditionally, this has been applicable to the shutdown of facilities, such as an arsenal or a GOCO, rather than to ammunition programs.

In a recent DoD Inspector General report in December, 1990, a related cost analysis issue was raised, focusing on how the Government could "save" through breakout by avoiding industry top-rates on subcontract materials purchases. The approach taken in this study (reference Section 4.2, Cost) is that there is no overhead cost incurred by an effectively managed company or government agency which is not paid for in the long run. The method of allocating those costs should be as complete and accurate as possible, and absorbed into the proper cost category. To avoid a burden cost on one product does not eliminate the expense, it merely distributes it differently. New DoD regulations on "Unit Cost Resourcing" are revising the government's cost accounting practices to fully load all support costs on the end item. This will cause the "out-of-pocket" cost versus system contract cost differences to largely disappear.

The New Defense Realities

The world has changed, and continues to change. The threats are expanding or changing in scope. The resources available to deal with the threats are contracting. The world competition for military markets is intensifying. And the ammunition products are growing ever more complex and technology-intensive. Perhaps the most critical question addressed during the HASP project was: "How do the changes in the world affect the method of buying goods and services from the Ammunition Industrial Base?"

It is this question and its corollaries which are addressed in this report (reference Section 4.1, Readiness). To establish a contextual framework, it is important that we consider why we produce ammunition in the manner that we do and how we prioritize when there are conflicts between objectives, as in, for example, competition versus readiness.

Ammunition Procurement History

In virtually every country in the world, development and production of weapons and ammunition were at one time guided and controlled by the central Government, with the Government often owning the means to production. There were logical causes for this state of affairs:

1. The products were inherently simple. The rounds of ammunition were basically metal tubes filled with explosives, with an impact fuze attached to the end. The government's risk of assuming responsibility for production was not substantial.

2. The need for such weapons established the government-only market, given the basic government responsibility for national defense. Unless the nation was at war, there was insufficient demand to sustain a private supplier base.

3. The large capital investments required to accomplish explosives loading, and large areas of buffer territory required to ensure general population safety, were easier to establish through government action.

4. The arsenal system in the U.S. was constructed in a crash program, between the World Wars, which required massive centralized guidance at a time before government acquisition techniques were as refined as they are today.

5. The major issue, still paramount today, was that of ready mobilization capability. It was originally believed that the Government could only have a guaranteed source of supply if it owned the factory itself. A change to this belief is the reason for the shift to industry systems management, an approach now favored by many of our allies.

Over the past forty years, the Army has gradually reduced its in-house, hands-on control over ammunition design and production. Unitary rounds, such as the M107 high explosive artillery shell, were entirely designed and produced within the Government, while the new 155mm SADARM round is contracted out as a system. The movement toward systems contracting with industry reflects the growth in relative complexity of ordnance items.

Ammunition production in the U.S. has continued to migrate toward the private sector:

- Mid 1960s — Arsenal converted to GOCOs
- Mid-1970s — Medium caliber ammunition systems contracted to industry
- Late 1970s — Active GOCOs reduced from 26 to 14
- 1979 — First tank ammunition systems contracted to industry
- Early 1980s GOCOs allowed to contract with "third parties"
- Mid-1980s — Last fuze assembly in GOCO plants
- 1988 — Mortar systems contracted to industry
- Planned — Active GOCOs reduced from 14 to 8.

Challenges to the Mobilization Base

As discussed in detail in Section 4.1, the total mobilization base is declining rapidly. By FY94 there will remain only eight officially workloaded plants, out of an original total of twenty-six. Meanwhile, the defense budget declines and changes in acquisition rules have taken a severe toll on the industry base as well. There is a strong desire within the OSD munitions community and the U.S. Army to increase Foreign Military Sales, and Direct Foreign Sales, to help supplement the "warm base" as the U.S. budget declines.

Financial Challenges to Ammunition Contractors

Beginning in 1985, the Competition in Contracting Act (CICA) and the changes in the tax code (regarding the "completed contract accounting" method and investment tax credit) began to impact defense contractor profits and cash flow. All the financial indicators have trended downward since 1985, as shown in Figure 2-1.

For many companies, survival will mean having to leave the defense business. A recent government report states that the number of U.S. companies providing goods to the DoD dropped from approximately 138,000 in 1982 to less than 40,000 in 1987.² This includes the disappearance of about 20,000 small businesses. The pace of supplier base reduction is accelerating.

The ammunition base has been directly affected by these business trends. For example, in 1989 the Defense Market Surveys Division of Forecast International analyzed the 70mm (2.75") rocket supplier base, and discovered that more than half of the companies had gone out of business or no longer wished to be considered suppliers of the items. Ford Motor Company recently divested itself of its ammunition division, as did Honeywell Inc. Chamberlain, an historic key supplier of artillery projectile metal parts, decided recently to close its Massachusetts plants. And Norris Industries, the only recently active

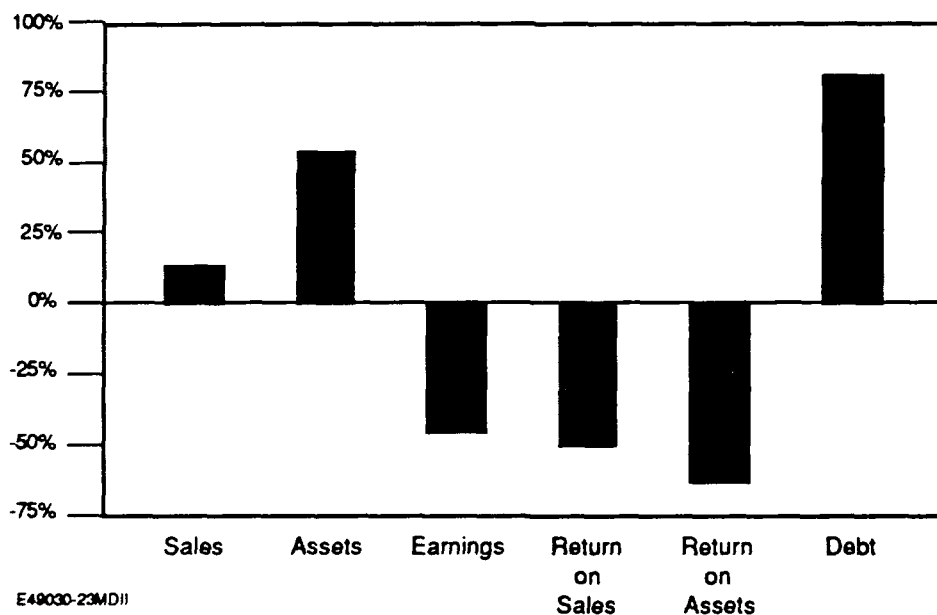


Figure 2-1. Financial trends of aerospace defense contractors—percent change from 1985 to 1989. (Source: Lopez, V.C. and Vadas, D. K. "The U.S. Aerospace Industry—A Global Perspective for the 1990s", p. 16, Annual Report of S&P Aerospace Index Contractors, from The Aerospace Research Center, AIAA, January 1991.

² "Deterrence in Decay: The Future of the U.S. Industrial Base," Press Release, Georgetown University Center for Strategic and International Studies, 16 May 1989.

manufacturer of the 155mm M483 cargo round, is operating at 20 percent capacity. Further reductions and shutdowns are on the horizon. Marginally capitalized and poorly managed defense firms are going out of business entirely.

Other major Western countries now procure all of their ammunition from industry, but preserve their mobilization base by ensuring the survival of key munitions suppliers. Their objective is to ensure a reliable source of supply for vital materiel. The Army is already cutting its GOCO base back to the minimum. It can ill afford to lose its commercial industrial base as well.

Summary

There is no simple answer to the complex issues which face the ammunition community. However, given the coming changes to the government cost accounting system, the down-sizing of the government arsenals, the reduced staffing levels, and the need for effective foreign sales marketing in an increasingly competitive world—it appears that systems contracting with industry for howitzer and other ammunition can play a potentially beneficial role in the world of ordnance acquisition. Increased industry systems contracting will further strengthen the existing teaming relationship between the Government and industry—to achieve the common goal of meeting AMCCOM's ammunition readiness mission.

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SECTION 3 METHODOLOGY

3.1 Study Methodology

To identify the advantages to the Government of using industry as the product systems manager for howitzer ammunition, we established a formal methodology to compare the relative merits of industry systems management and government systems management approaches. This methodology is based on the time phasing and primary attributes of the Army material acquisition process.

The Army's material acquisition process exists to provide a prescribed sequence of events and decisions that will lead to efficient and effective fielding of fully supportable systems that are responsive to Army needs. It is expected that products developed, produced, and fielded using this process will result in: 1) a system that will enhance the U.S. "readiness" posture; 2) an affordable and "cost" effective product delivered on schedule; and 3) a "quality" solution that is producible, reliable and effective.

To evaluate the benefits of industry system management for howitzer ammunition, we established and implemented the study methodology illustrated in Figure 3-1. Using this framework, we reviewed the various acquisition strategies for howitzer ammunition and other munitions products with experienced managers at Alliant Techsystems and the Government, including both active duty and retired personnel. We investigated the different acquisition strategies from three perspectives: the contracting regulations that govern a strategy, the historical procurement data associated with a strategy, and perceived current trends. We also asked these individuals to define the evaluation criteria that should be applied to the selection of a systems manager.

Contracting regulations were examined on the basis of both legal (for example, the FARs, the CICA, and the Arsenal Act) and regulatory considerations (such as contractor certification and SB/SDB goals). The bulk of the study effort was devoted to the analysis of the historical procurement data, current trends, and system management evaluation criteria.

The first step of the analysis task was to examine the historical data, current trends and evaluation criteria, and identify the underlying "drivers." A total of ten key drivers were defined for the three acquisition attributes:

Acquisition Attribute: Readiness

- World and budget environment
- Acquisition policy and political considerations
- Product management, requirements, and improvements
- Technology base readiness
- Mobilization base readiness
- Foreign sales considerations

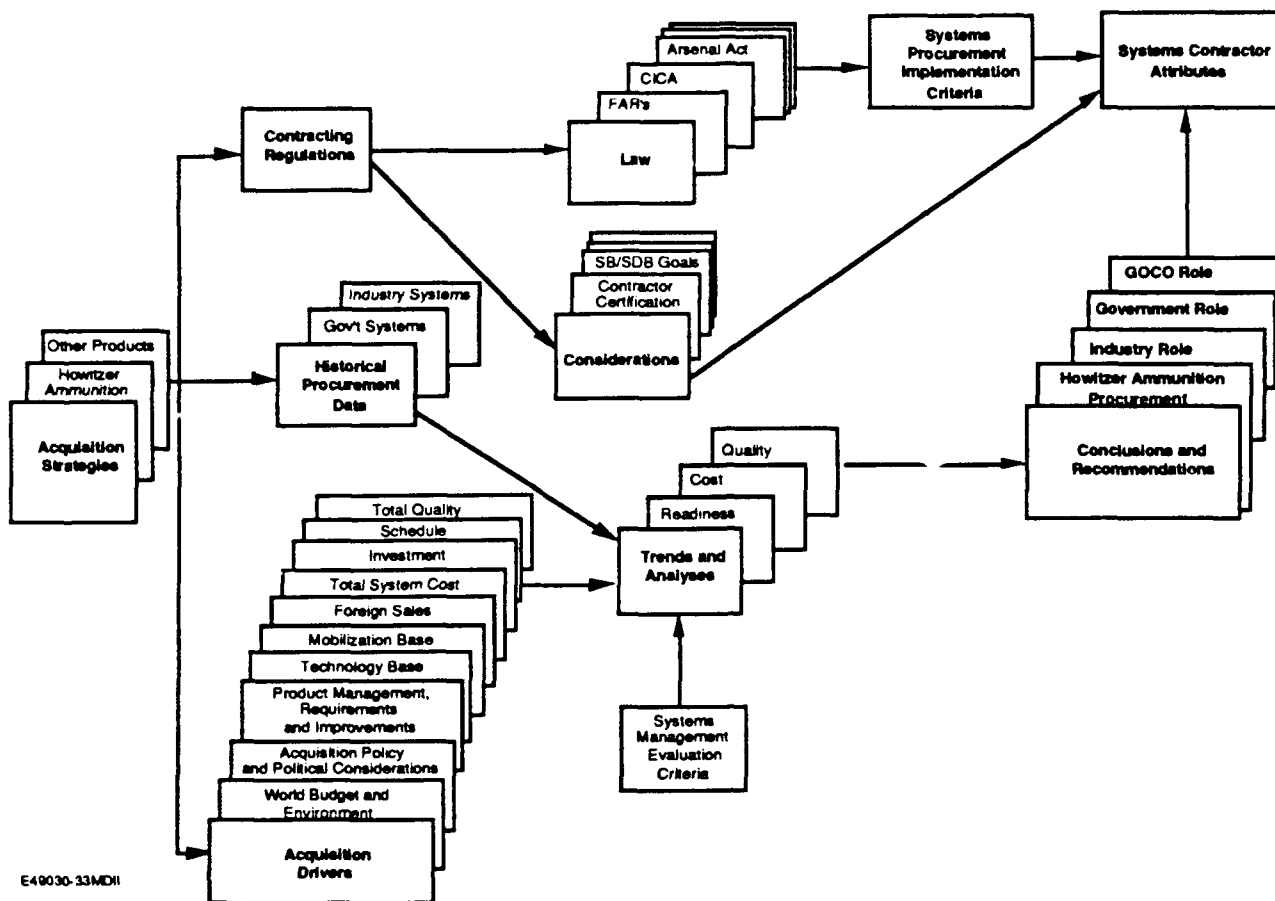


Figure 3-1. HASP study methodology

Acquisition Attribute: Cost

- Total cost
- Investment
- Schedule

Acquisition Attribute: Quality

- Total quality management

Second, we defined the dimensions of the HASP study as a three-dimensional, 3 by 4 by 10 matrix consisting of the attributes, product life cycle phases, and key drivers, as shown in Figure 3-2. This matrix arrangement was deliberately chosen to ensure that linkages and interdependencies of drivers between the acquisition attributes would not be overlooked. As an example, investment is a key driver for acquisition cost but was found to have an important connection to product improvements, technology base, schedule, and total cost.

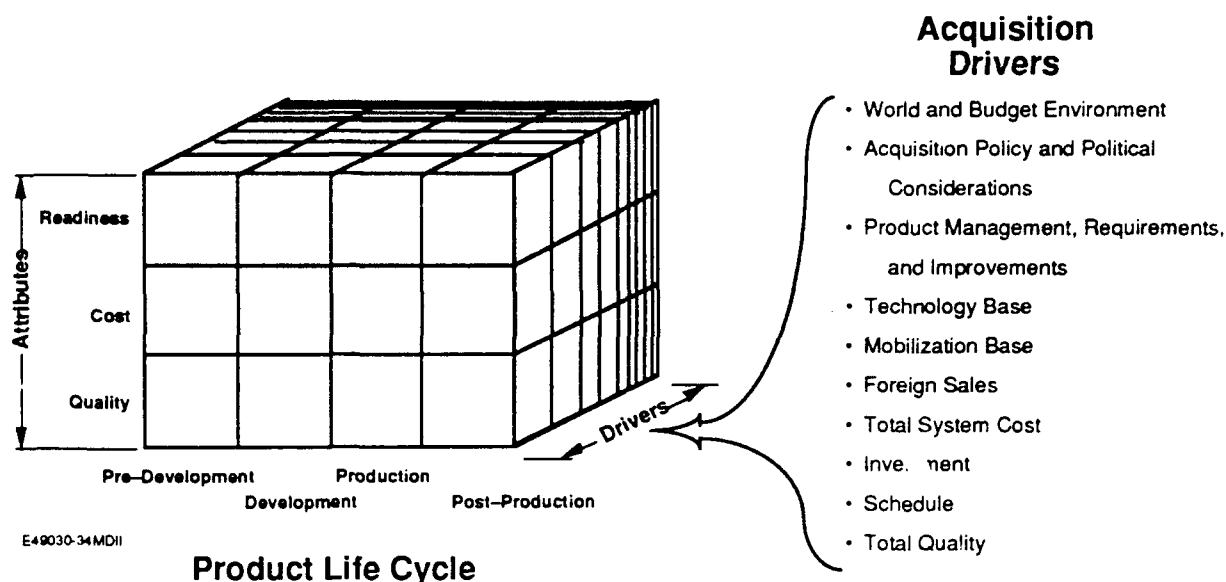


Figure 3-2. Study dimensions

Third, we established and used the attribute scoring method shown in Figure 3-3 to identify areas where the HASP study indicated a significant benefit could be obtained through the use of industry systems contracting. This attribute scoring methodology was applied independently to each of the ten acquisition drivers and then summed. For the purposes of this study, drivers were assumed to be of equal importance and were therefore assigned equal weighting. A "+" sign was used to signify an advantage or a benefit to the Government deriving from industry systems management. (Note: Our in-process review in January featured a scoring system using "I" for industry systems management, and a "G" for government systems management. This I versus G scoring by approach was dropped in favor of a simpler "+" scoring approach which was easier to implement and understand.

To conduct this study, we assigned acquisition drivers for analysis to selected management and staff personnel at Alliant Techsystems, based on their particular experience and background. The personnel were directed to consult with internal and external resources as necessary. Data were obtained from a variety of sources, including AMCCOM, HQDA, OSD, and OTA. The detailed analyses, using the methodology described in this section, are provided in Section 4.

Since we anticipated that numerous conclusions and recommendations would be generated from our analyses, we structured the study methodology to focus the results into a usable format. Trends, conclusions, and recommendations were organized by driver, and summarized by acquisition phase.

3.2 Survey Methodology

As an add-on to the HASP Study, Alliant Techsystems was directed to conduct a sampling survey of the Ammunition Production Base to elicit industry and government views on the best ways to meet future needs for howitzer and other types of ammunition. The survey's objective was to test the analyses and

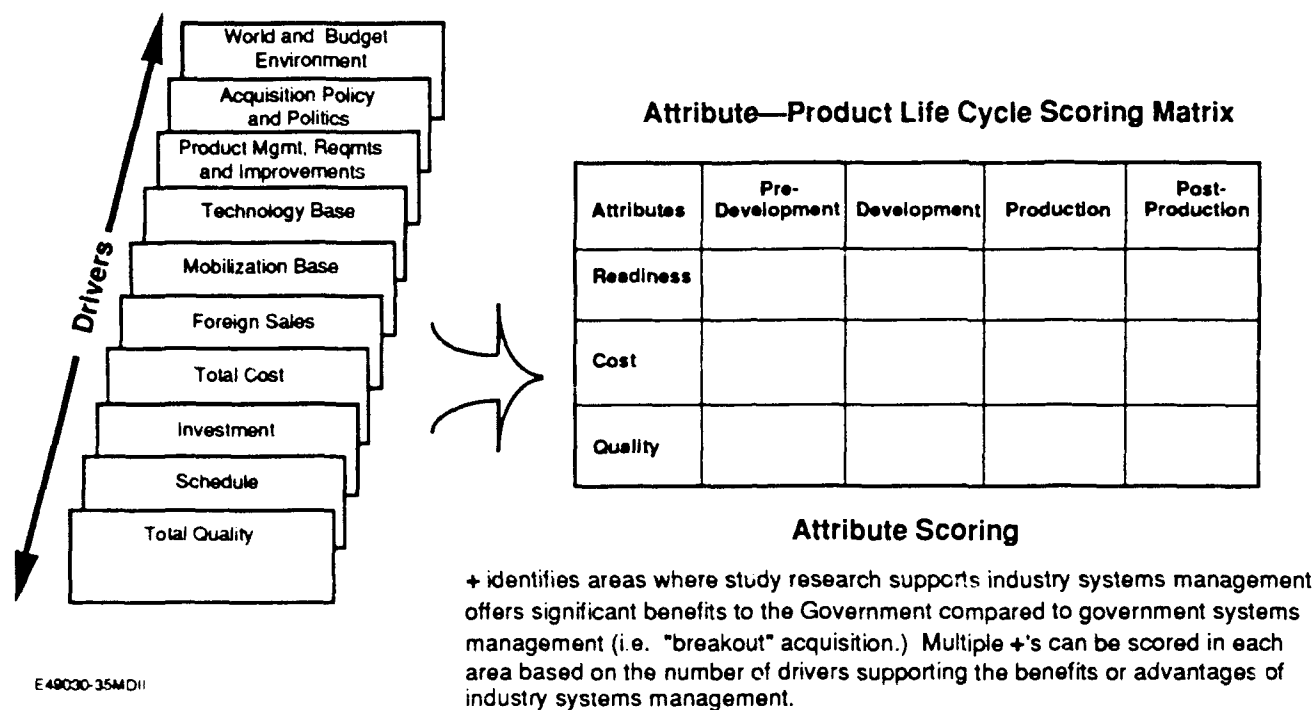


Figure 3-3. Attribute scoring method for assessing industry systems management

assumptions of the study report, and to determine what types of implementation issues would require attention to ensure effective results.

To maximize industry and government confidence in the integrity of the process, Alliant Techsystems subcontracted the survey effort to a leading data collection and analysis firm, Questar Data Systems, Inc. In addition, the American Defense Preparedness Association (ADPA) Industry Affairs Division joined in as co-sponsor of the survey. Alliant Techsystems helped draft the initial questionnaires, coordinated the mailing/responders list with AMCCOM and HQ AMC, assisted with decisions about inclusion of question topics, and about cut-off dates for responses. An Alliant Techsystems representative also participated in directly administering the survey to a small group of Washington-area government personnel, as a response expedient suggested by the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition.

Those Surveyed

The final mailing list included 45 ammunition companies and about 20 government managers or recent government retirees. The industry firms included seven firms who operate GOCO plants, seven which could be generally categorized as current or potential ammunition systems contractors, 14 "normal" small businesses, 3 small disadvantaged businesses, 7 members of what AMCCOM would consider to be the core howitzer ammunition base, and 14 other large businesses who supply ammunition components on either the prime or subcontract level. (Note: other industrial base members were included in other

categories, such as GOCOs.) The numbers above do not add up to 45, because some of the firms fit into multiple categories.

A conscious effort was made to include all relevant categories, and to offer all companies which AMCCOM believes may desire to express their views the opportunity to do so. The government mailing list included appropriate persons at AMC, AMCCOM, ARDEC, OSD, DA, and 4 to 5 retired employees, such as former ASARDA managers and past Commanders of AMCCOM.

Survey Response Forms

Three separate questionnaires were developed; copies are included in Appendix B of this report. The three categories were Government, Small Business, and Baseline (i.e., large business). The Government form did not inquire about such topics as industry investment decisions. The Small Business form included SDB questions and covered issues such as relationships with system primes and preferences for government contracting or subcontracting. The Baseline form included optional questions on GOCO operations and on the subject of Small Business and SDB subcontracting. Categorizing questions were included to allow analysis of the responses by category of company.

Conduct of the Survey

The questionnaires were issued by ADPA, and furnished along with a postage-paid return envelope addressed directly to Questar. Following the time "on the street", the industry and government inputs were analyzed and evaluated by Questar, who submitted a summary report to Alliant Techsystems and ADPA, along with non-attributed response comments where appropriate. To protect the anonymity of the respondents, no identified responses were forwarded to Alliant Techsystems.

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SECTION 4 SYSTEM MANAGEMENT DRIVERS

This section of the Howitzer Ammunition System Procurement (HASP) Study final report discusses the main attributes of howitzer ammunition acquisition—readiness, cost and quality. As a means of facilitating detailed analysis, we subdivided the ten drivers into these following study areas:

Section 4.1, Readiness, consisting of:

- 4.1.1 World and Budget Environment
- 4.1.2 Acquisition Policy and Political Considerations
- 4.1.3 Product Management, Requirements and Improvements
- 4.1.4 Technology Base
- 4.1.5 Mobilization Base Readiness
- 4.1.6 Foreign Sales Considerations

Section 4.2, Cost, consisting of:

- 4.2.1 Total System Cost
- 4.2.2 Investment
- 4.2.3 Schedule

Section 4.3, Total Quality Management, a self-contained section.

In total, we studied and analyzed ten different acquisition drivers, which correspond to each of the subsection headers listed above. Each subsection is structured to include the following items—an Introduction, a Background discussion, a Trends and Analyses discussion, and a listing of Conclusions and Recommendations. It should be noted that some drivers were amenable to more objective analysis, while others could only be looked at subjectively, frequently due to limitations on available data.

4.1 Readiness

This section consists of two background analyses (World and Budget Environment, Acquisition Policy and Political Considerations), a programmatic analysis (Product Management, Requirements and Improvements), two basic readiness analyses (Technology Base, Mobilization Base), and a brief discussion of Foreign Sales Considerations. The background discussions provide a broad perspective for understanding and analyzing the readiness issues. The programmatic discussion is howitzer ammunition specific, and likewise provides a lead-in to the readiness analyses. While foreign sales could have been discussed in the context of total cost, we included it in this section because of its potential impact on ammunition base readiness.

4.1.1 World and Budget Environment

The objective of this section is to survey the global and domestic buying environment for howitzer ammunition, and to discuss its impact on systems contracting.

The sole reason for the existence of the Army's Armament Munitions and Chemical Command (AMCCOM) is to supply weapons and ammunition to the fighting forces in the field. The world and budget environment in which this must be accomplished poses tremendous challenges to AMCCOM management. Within this environment, three trends are very apparent: governments around the world are spending less on defense, governments around the world are divesting themselves of their industrial responsibilities and facilities, and the military threats are changing in intensity, complexity, and identity. By responding directly to these challenges and trends, AMCCOM can safeguard its mission. By placing the greater responsibility on full-service ammunition contractors through industry systems contracting, the U.S. Army and AMCCOM can more readily surmount the severe global and domestic challenges to its mission.

World Situation — Background, Trends, and Analyses

The last ten years have seen more change in the world military marketplace than in any decade since the period between the end of the 1930s and the start of the Cold War. The 1979 Soviet invasion of Afghanistan and Iranian hostage crisis triggered the U.S. "rearmament" era, which prompted the FY82 defense budget supplement, and the growing FY83-FY86 budgets. By 1989, with the dramatic fall of Eastern Europe as a Soviet client state buffer zone, the world moved from a Eurocentric and bilateral power axis, to a multi-polar, diffused power status, as attention migrated toward the Middle East, Central America, and Africa.

As the threat of a Soviet conventional invasion through Eastern Europe has declined, low intensity conflicts, usually associated with police actions and guerrilla warfare, have been gaining ascendancy throughout the 1980s, as shown in Figure 4-1, and reflected in the formation of the Joint Special Operations Command (SOCOM).

The actions in Grenada and Panama, plus support for the Nicaraguan opposition, were characterized by the rapid deployment needs of the light forces and reinforced the downgrading of high intensity, ammunition-intensive ground wars of the Central European variety.

However, the recent Persian Gulf War, fought against a Third World dictator, proved that the size of the country is irrelevant to the intensity of the conflict. To take and hold territory, no matter where, requires masses of troops, armored forces, artillery concentrations, and huge expenditures of ordnance. We now face a multi-faceted set of threats around the world, in all locations, ranging from limited intensity conflicts to full scale air and ground wars with a massive need for ammunition to support a high volume of fire.

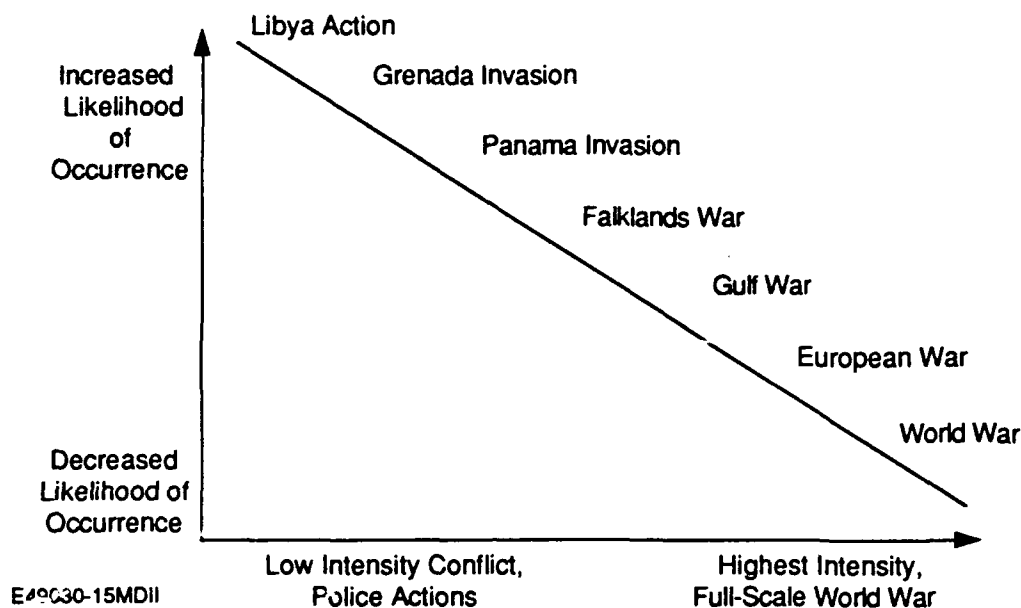


Figure 4-1. The new threat calculus

Industry has historically given the U.S. Government what it has asked for. During World War II, the Government emphasized rapid, high rate production. During Vietnam, the Government needed rapid product adaptations and improvements to meet the differing jungle environment. During the late 1970s, the Government shifted emphasis to very advanced, electronic-based technologies. During the first half of the eighties, there was a broad consensus favoring a rapid re-armament, with improved training and logistics support. Through all of these changes in direction, the overriding consideration was maintenance of a viable mobilization base with adequate ammunition stockpiles.

In the mid-eighties, a flood of reforms led to a much greater emphasis on competition in procurement. When competition became the goal, industry responded by reducing relative investments in product and quality improvements, and facilities. Discretionary resources were directed toward winning contracts, by providing the minimum product which would pass inspection.

From the perspective of TRADOC, procurement and equipment trends are changing again. In a 1991 presentation to industry, TRADOC Commanding General John Foss contrasted two acquisition scenarios—traditional and future. His perspective is presented in viewgraph form in Figure 4-2.

Gen. Foss' comments indicate that the Army's new emphases will be on maintaining an ammunition base of at least one source per round, and achieving continuous product and quality improvement to obtain the "best value" for the limited money available.

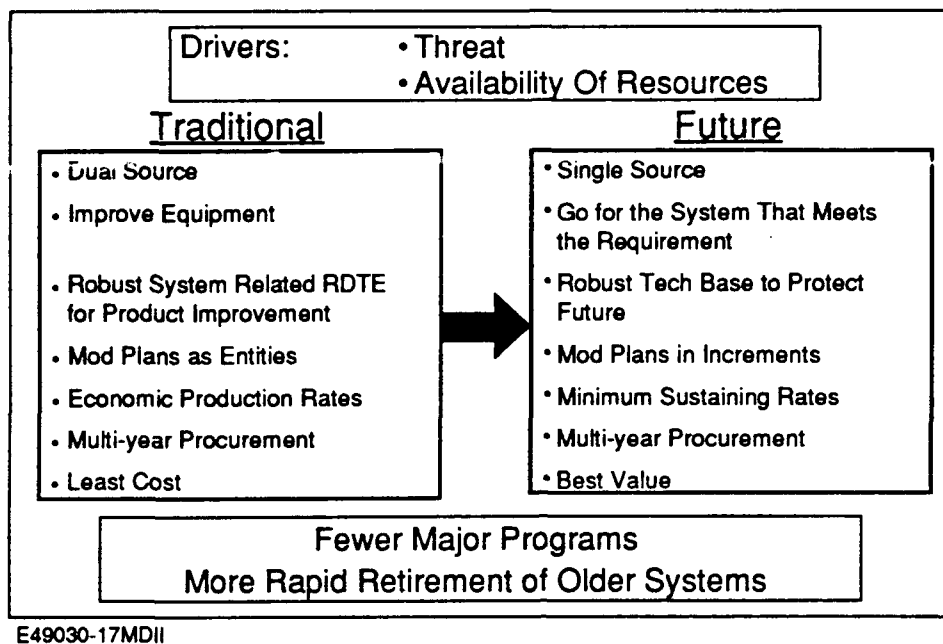


Figure 4-2. Future acquisition and equipment trends. (Source: General John Foss, Commander, TRADOC, 1991 Presentation)

The U.S. Budget — Background, Trends, and Analyses

The U.S. Defense Budget Decline. The U.S. defense budget has declined by 34 percent in real (inflation-adjusted) terms over the past five years. Figure 4-3 summarizes the top level declines in DoD budget authority as a function of U.S. Gross National Product (GNP) and U.S. Government spending. With defense expenditures reduced to 19 percent of the federal budget in FY92, non-defense expenditures now consume most federal revenue. The defense budget baseline for FY92 dropped by 10% in less than 8 months, and the FY95 projection was reduced by 20%, as Table 4-1 reveals.

Operations and Maintenance (O&M) Budget. The O&M budget has become the largest DoD budget category. This account includes civilian salaries, base support, and equipment overhaul. The real (inflation adjusted) cost of defense personnel increased in the early eighties at a rate of three percent per year. Since O&M is an annual appropriation, with immediate outlays, it is by far the easiest place to save money quickly. Investment accounts, such as procurement, do not yield dollar savings immediately and have already taken heavy reductions. The DoD O&M account will decline four percent by FY93, from \$89 billion to \$85 billion, while procurement will decline 18 percent, from \$81 billion to \$67 billion.

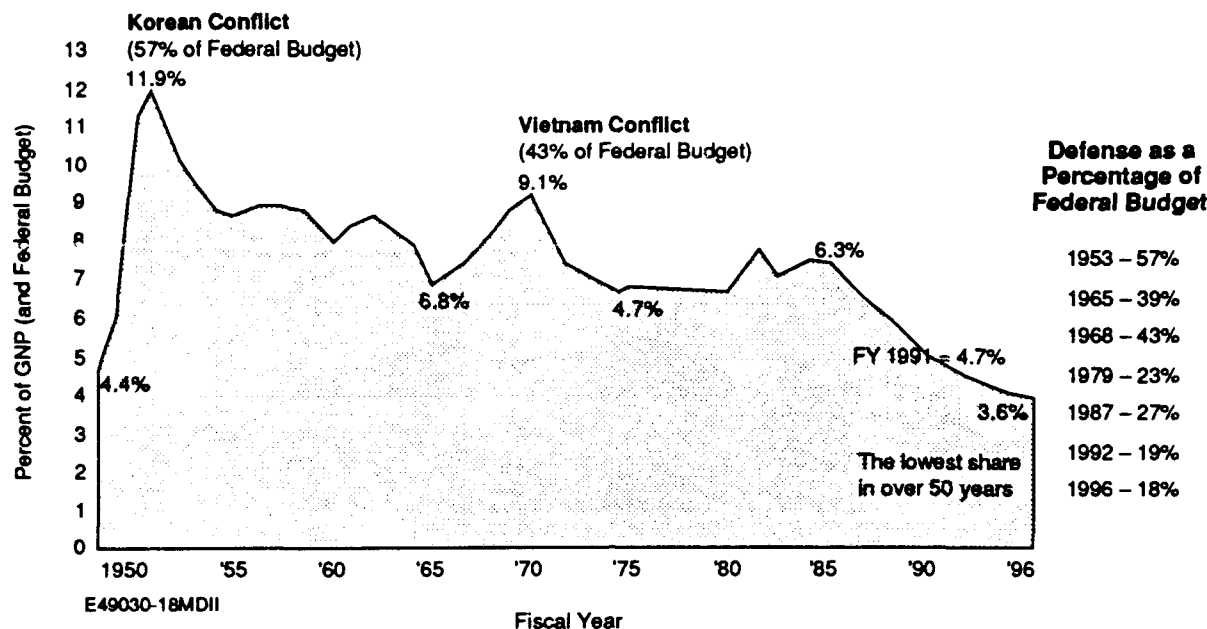


Figure 4-3. Defense outlays as a percentage of GNP and federal budget. (Source: President's Budget and Sec. Cheney's Speech to the American Enterprise Institute, 21 February 91.)

Table 4-1. DoD budget reductions. (Summit Baseline based on defense spending at FY1990 levels, plus inflation.)

	FY1991	FY1992	FY1993	FY1994	FY1995
Summit Baseline, July 1990 (in \$ billions)	\$303.50	\$315.60	\$327.40	\$338.70	\$349.30
President's Budget, February 1991 (in \$ billions)	\$273.00	\$278.30	\$277.90	\$278.20	\$280.70
Reduction (in percent)	-30.5	-37.3	-49.5	-60.5	-68.6

Army and Ammunition Funding Decline. The Army budget, already the smallest of the services, declined further between FY88 and FY91. The percentage of the procurement budget allocated to ammunition will fall even more rapidly. The net effect is that the FY92 Army ammunition budget will be half of the FY88 allocation. As Figure 4-4 shows, both the total DoD ammunition and Army ammunition allocations have declined significantly from their 1986 peak.

Army Staffing Reductions. As shown in Table 4-2, the Army is more manpower intensive than the other services, and is thus susceptible to deeper personnel cuts over the coming year. As the active duty roster is pared, so also will the support staff for that reduced force be cut back. From 1985 to 1996,

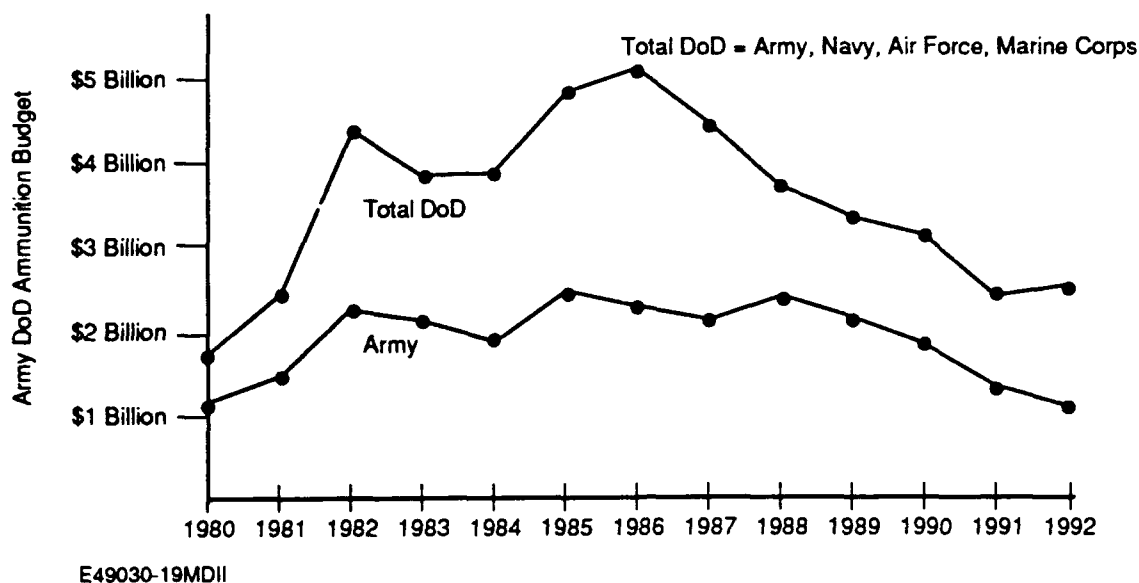


Figure 4-4. Total ammunition budget authority. (Temporary increase in 1991 reflects costs associated with Operation Desert Storm. Long term trend is down.)

Table 4-2. Active manpower reduction. (Source: "The Chart Page-Snapshots of the New Budgets," *Air Force Magazine*, April, 1991, p. 66)

Service	FY87	FY95
Army:	781,000	536,000
Navy:	587,000	510,000
Air Force:	199,000	171,000
USMC:	607,000	437,000
Civilians:	1,133,000	940,000

AMC's workforce will shrink from 130,000 to 93,000 according to current AMC projections. As shown in Figure 4-5, Army civilian personnel spaces will decline by 12,126 in FY92 alone, with 8,000 coming out of AMC subordinate commands.³ AMCCOM will be asked to shoulder more staff reductions than other commands. AMCCOM is the largest of the AMC major subordinate "hardware" commands, with more than twice the headcount of the next largest activity (CECOM). At MG Greenberg's address to the

³ "Army: Management reforms will save \$1 billion less than earlier estimates", *Inside the Army*, p. 7, 29 April 1991

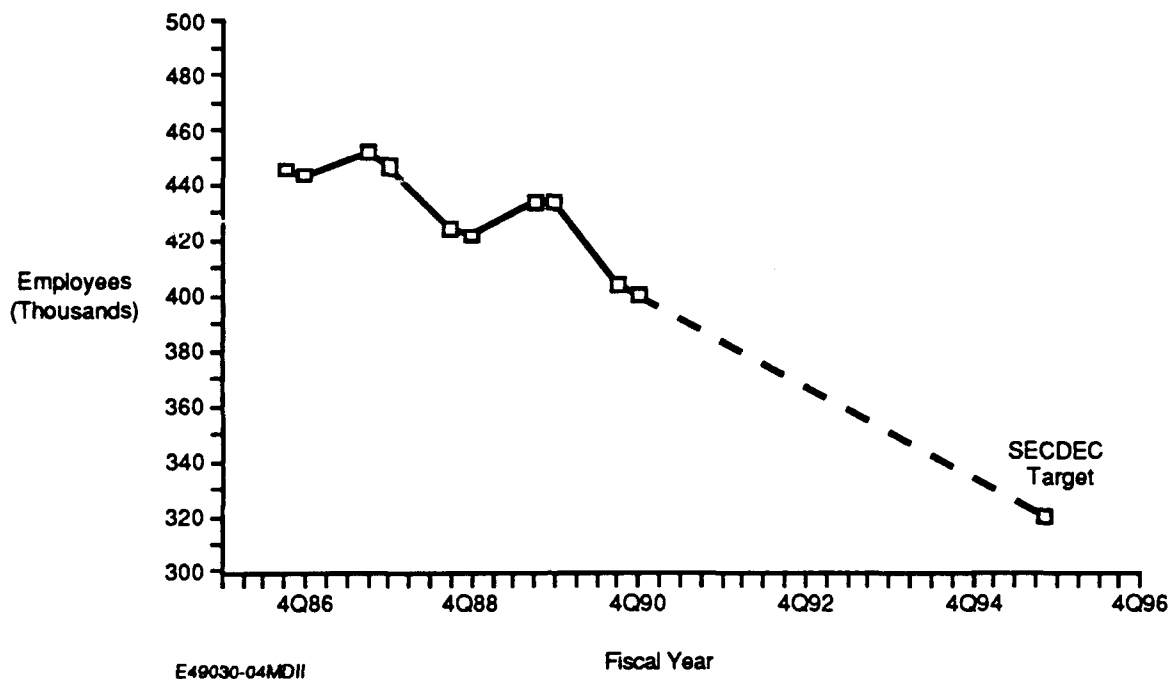


Figure 4-5. Army civilian employee declines. (Source: HQDA, May 1991)

ADPA annual LAP meeting in March of this year, he projected that the AMCCOM personnel level is scheduled to decline from 22,000 to 17,000 persons.⁴

Procurement Workload Increase. Normally we would track the budgets and assume that there would be a commensurate decline in procurement workload. However, the number of procurement actions is not directly proportional to the budget allocations. This is particularly understandable when we consider the amount of new "reform legislation" (about 150 new regulations each year) which have been directed at DoD procurement functions since the mid-1980s.

The AMCCOM job will not become smaller or easier just because the dollars expended are shrinking. Work required per procurement action is increasing, as confirmed by a steady increase in procurement lead time tracked since 1970 by the AMC Procurement Policy Office. AMCCOM personnel will be asked to do the same job, with reduced budget and fewer people. Thus, the decline in AMCCOM headcount cannot be achieved solely through reductions in the procurement staff, even though there are fewer procurement dollars spent. Other AMCCOM organizations (such as Production, Plant Operations, and Quality Assurance) will also lose people.

Privatization — The U.S. Army and AMCCOM have no choice but to down-size. The maximum projected budgets for the 1990s already are predicated upon a reduced Army staff. The worldwide trend to cope with reduced government headcounts is toward "privatization." For all of the

⁴ Greenberg, MG Paul, ADPA LAP Section, Annual Meeting Keynote Address, Las Vegas, Nevada, 13 March 1991

efficiency, motivation, cost, and budget reasons mentioned previously, this is an accelerating trend in Europe and other industrialized countries. In recent years, Netherlands, Great Britain, and Sweden have all converted their government munitions organizations into private companies. Between 1988 and 1991, more than forty different previously government-managed functions in thirty countries were planned or converted into industry-managed functions. These functions ranged from airline operations, to munitions production, to atomic weapons research.

There was a concern, prior to Operation Desert Storm, about direct ammunition industry support for troops during hostilities. This mobilization concern was a commonly cited reason for maximizing government control of ammunition production management and support. According to ASARDA and DCS-Ammunition, this concern was laid to rest by success stories such as those of the 120mm tank ammunition and the TOW IIA missile, which performed flawlessly in the desert under extraordinary contractual conditions. This fact was confirmed in the FY92 House Armed Services Committee Report; direct, on-site support was provided by many U.S. companies and their employees, proving the commitment of private industry to U.S. mobilization.

Conclusions

With regard to the world and budget environment, we can conclude the following:

- The threat will be more complex, and rapidly changing
- The DoD budget, and the Army ammunition budget in particular, will shrink considerably in the 1990s
- Government personnel capacity for ammunition systems integration and management, and procurement of subsystems and components, will be significantly reduced due to declines in staffing budgets
- Privatization of ordnance production will continue and accelerate, both globally and domestically.

Recommendations

Based upon the above analyses and conclusions, we offer the following recommendations to the U.S. Army:

- For most howitzer ammunition rounds, the U.S. Army should utilize systems contracting with industry to reduce the number of procurement actions required from the downsized AMCCOM staff
- The U.S. Government and Army should study the European experience with ordnance privatization, analyze the reasons for the trend, and consider their applicability to the U.S.

4.1.2 Acquisition Policy and Political Considerations

The objective of this section is to describe and analyze the legal and regulatory conditions and the political environment which influence the ammunition acquisition process, and to describe the potential benefits of industry systems contracting in dealing with those issues.

During the rise and fall of the DoD budget through the eighties, there has been an enormous increase in new rules, at the same time as multiple political factors and influences have risen in visibility. The DoD buying community converted from DAR to FAR, then implemented the Competition in Contracting Act (CICA). Nine major pieces of legislation were passed regarding Small Business (SB), and the newest targeted subset, Small Disadvantaged Business (SDB). The regulations are discussed in the Acquisition Policy and Competition subsection, while political factors such as media roles in DoD acquisition, Congressional issues, intragovernmental relationships, and effects of industry marketing are dealt with in the Political Influences subsection.

In general, the regulations are completely compatible with procurements of ammunition on a systems basis. However, there is cultural and political resistance to implementation which will require AMCCOM and industry teamwork to overcome.

Acquisition Policy and Competition — Background, Trends, and Analyses

Acquisition law and regulation issues which are applicable to ammunition acquisition include:

- Competition—in particular the Competition in Contracting Act (CICA)
- Breakout guidelines of DFAR Section 217.7202
- Socioeconomic legislative requirements and goals
 - Small Business (SB)
 - Small Disadvantaged Business (SDB)
- Emerging contract award criteria—"Best Value"
- Contractor Certification Program (CCP)
- Multi-year procurement
- Cost Accounting Standards (CAS) and Unit Cost Resourcing (UCR)

These legal and regulatory issues are summarized in Table 4-3. Some of the items will be discussed further to ensure clear understanding of all issues and implications.

Competition. All mobilization base production is "competition restricted", and thus categorized under CICA as "other than full and open competition." The need for competition is frequently cited as a primary reason for component breakout. The CICA established "breakout procurement center representatives" to enhance competition at the component level, which is a valid concern for noncritical items. However, there is an apparent conflict between maximizing competition and maximizing readiness. What is seldom noted is that Congress, in the CICA law itself, clearly subordinates competition and multiple sourcing to readiness. DAR 6.302-1 through 7 describe the authorized Exceptions to "full and open competition." For some categories (6.302-1, -2, and -6) there are specific instructions to the contracting officer to find as many sources as is practicable. For the Industrial Mobilization category covering munitions, there are no additional instructions to the contracting officer whatsoever. The exception to "full and open competition" applies to all aspects of MOB base procurement. There is no language subordinating readiness to any other law or regulation (including socioeconomic factors).

Table 4-3. Acquisition issues overview

Acquisition Issue	Applicable Laws and Regulations	Summary	Favors Government or Industry Systems Management	Trends and Recommendations
Competition	Competition in Contracting Act (CICA) 10 USC 2304 FAR Part 6	Mandate for "full and open competition", with statutory exceptions for mobilization, limited sources, etc.	No inherent bias – budget cuts driving toward single sourcing.	<ul style="list-style-type: none"> Increased in 1985-1989, declined beginning in 1990 as budget reductions took effect. Recommend emphasizing the primary objective of mobilization base readiness. Compete new systems opportunities among only qualified base contractors.
Small Business and Small Disadvantaged Business (SB/SDB)	Small Business Act 10 USC 631, FAR Part 1	1) Assure a "fair share" of DoD dollars being placed with small business and SDB's. 2) Build ownership of businesses by disadvantaged groups.	Historically Favors Government Systems Contracting due to "Prime" awards emphasis. New congressional interest in SDB subcontracting allows altered reporting methods.	<ul style="list-style-type: none"> Prime awards constant at about 20% in DoD, with subcontracted SB awards at about 40%; SDB's still at 3% due to lack of qualified sources. Recommend 1) Combine reporting of prime SB awards and subcontract awards, but maintain growth of total dollars to small business; 2) Subordinate SB/SDB goals to base readiness objectives; and 3) Heavily emphasize Mentor-Protégé program.
Contractor Certification Program (CCP)	Pending AMC Handbook	AMC-planned program in process of being implemented. Future systems buys may be restricted to certified contractors. Program includes continuous process improvement, measurement, and validation, to increase readiness, reduce total costs, and improve quality.	Favors Industry Systems Contracting	Recommend implementation of CCP and meaningful incentive to become certified, with positive credits given to qualified contractors under "Best Value" evaluations.
"Best Value" Award Criteria	FAR Part 15, Sub 6; DoD Directive 4105.62E(3)(d)	Conscious shift away from "low bid wins" approach to an integrated evaluation of quality, schedule, technical and management capability, and life-cycle cost.	Favors Industry Systems Contracting	<ul style="list-style-type: none"> Complexity of evaluation tends to make "Best Value" less compatible with component purchasing versus all-up systems procurement. Recommend emphasizing "Best Value" as baseline source selection criterion, with factors applied to needs of the specific program.
Multi-year Procurement	FAR Part 17 PL 100-456 Sec 107	Combine program years into a single contract to increase stability and lower cost. Not practical at component level due to smaller savings potential versus administrative burden.	No inherent legal bias, but practical aspect tends to favor Industry Systems Contracting	<ul style="list-style-type: none"> Much talk, but little action due to overly restrictive criteria. Complex political factors have limited application, but technique remains one of the best for reducing costs and increasing readiness. Recommend: Continue to use multi-year procurement wherever feasible.
Component Breakout	DFAR 217.7202	Not applicable to breakout ammunition production as practiced (217.7202-1(a)). Applicable body of regulation is Government make/buy decision for system management, per OMB A-76.	In Transition from Government Systems Contracting to Industry Systems Contracting	In flux, due to competing pressures of budget cuts and socioeconomic legislation.
Cost Accounts Standards and Government Unit Cost Resourcing	Program Budget Decision 901 and 904	Requires full "Burdened Costing" of end items with OMA-supported factors	Neutralizes differences between two types of systems management	Eliminates prior apparent cost differentials between breakout and systems contracting by revealing Government hidden costs.

Obviously, the responsible PCO will desire competition within the mobilization base wherever requirements are sufficient, and will similarly seek to maximize Small Business and Small Disadvantaged Business (SB/SDB) opportunities within the larger objective of mobilization readiness. Thus, even though competition can occur as effectively at the system level as at the component level, AMCCOM has authority to manage acquisition to maximize readiness, regardless of any other law or service objective. The system contractor will, of course, procure competitively, where appropriate, from his subcontractor base, using "Best Value" as the primary evaluation and selection criterion.

"Best Value". This new, official DoD policy applies normal consumer decision-making techniques to award decisions on the basis of "best value" instead of "minimum qualification, low bid wins" selection criteria. The latter criteria largely arose out of reaction to past "anti-goldplating" sentiments, beginning as early as 1935 with the Nye Hearings. Up until very recently, public pressure had pushed DoD toward an emphasis on minimizing bid prices. By contrast, "Best Value" award criteria comprise an integrated assessment of quality, life cycle cost, technical and management capability, and applicable past performance by a source selection authority who has the interests of the field soldiers as top priority. "Best Value" was defined and institutionalized in DoD 4105.62, E(3)(d), "Selection of Contractual Sources for Major Defense Systems" and in subsequent OSD acquisition policy circulars. It is clearly compatible with industry systems contracting, and much less compatible with breakout procurement, because it is complex, time consuming, and vulnerable to protest at the component level.

Cost Accounting Standards (CAS) and Unit Cost Resourcing (UCR). As one outcome of the Packard Commission, the application of CAS principles to AMC is now required by OSD Policy (Program Budget Decisions 901 and 904). This will cause administrative costs now largely covered by OMA to be direct-charged to the applicable program, improving the accuracy and traceability of total costs. Following implementation of UCR by AMCCOM ammunition managers in 1994, exposure of these hidden costs will significantly reduce differences in visible cost between industry systems contracting and Government systems contracting (breakout). These hidden costs are discussed more thoroughly in Section 4.2.1, Total System Cost.

Political Considerations — Background, Trends and Analyses

There are two major issues regarding industry systems contracting which are not regulatory in nature, but address very real and subtle political forces which have significant impact on the acquisition process:

- Procurement procedures
- The role of Congress and its interest in Small Business (SB) and Small Disadvantaged Business (SDB) programs.

Procurement Procedures. In recent years, Congress has become quite sensitized to negative publicity and has passed much new legislation which instructs DoD on how to buy items.

Government procurement, and the approved procurement systems of industry, follow the same basic laws and regulations. However, implementation of more subjective criteria is easier to implement by industry systems contractors, as has been publicly acknowledged by AMCCOM management in reference

to "Best Value."¹ These and other procurement differences between the Government and industry are listed in Table 4-4.

Due to these differences, the Government is hampered in implementing new procurement practices which move away from pure dollar evaluations, particularly at the component level. When more of the component and subsystem procurement process is entrusted to high caliber systems contractors, the total system acquisition process can be enhanced by the higher incidence of "Best Value" evaluation and "Total Quality" supplier relationships.

Table 4-4. Procurement differences between Government and industry

Government	Industry
Freedom of Information Act (FOIA) and other provisions has made subjective evaluation criteria burdensome to defend administratively	Buyer judgement is normally accepted if reasoning is sound
Multiple levels of implementing regulations (Public Law, FAR, DFAR, AFAR, AMC AI, AMCCOM AI) has resulted in an attempt to standardize buying practices across commands	Buyer has some flexibility to innovate buying techniques, within the rules and regulations of the Government
"Anti-deficiency Act" has prevented proactive effort to minimize program cost and stretchouts caused by administrative funding delays	Buyer can advance release funds resulting in increased program continuity

Congress and Small Business Programs. Congress has in recent years taken more and more interest in defense acquisition. It is easy to see why: DoD supports approximately 8 million jobs in all sectors, and each \$1 billion in DoD spending is worth approximately 30,000 jobs for the Government, prime contractors, and subcontractors.

In the past, the Congressional regulation system tended to favor prime Small Business and SDB contract awards over subcontract awards. For example, the FY90 Small Business Re-authorization Act, PL 101-574, Sec. 208, added a new provision requiring procuring activities to justify "bundling" (i.e., consolidation of requirements to allow more efficient government contracting). The language specifically referred to "Small Business Prime Contract Participation". This was included after a small business lost its Comptroller General protest of an award to a larger firm (Comptroller General Decision, B-231637, 22 September 1988).

SBA goal-setting is a challenging issue, but not intractable. Pertinent legislation is summarized in Table 4-5. When acquisition decision-makers at high Army and AMC levels were queried about this issue, there was a consensus in the following areas:

¹ Colledge, Craig, ADPA LAP Section Annual Meeting, Las Vegas, Nevada, 13 March 1991, in response to a question about CICA from Dr. Lee Estabook of Thiokol Corp.

Table 4-5. Currently relevant legislative acts regarding Small Business and Small Disadvantaged Business contracting

Statute Number Regarding Small or Small Disadvantaged Business	Act Title	Effect	Status
Public Law (PL) 95-507 DTD 1978	Amendments to the Small Business Act	<ul style="list-style-type: none"> Added powers to small business specialists in acquisition decisions, established requirement for small business subcontract plans. 	<ul style="list-style-type: none"> In place, as modified by subsequent law.
PL 99-661, Section 1207 DTD 1980	National Defense Authorization Act of FY87	<ul style="list-style-type: none"> Established "fair share" formulas of 5% goals to SDB, authorized 10% premium payment to SDBs and established SDB set aside programs. 	<ul style="list-style-type: none"> Substantially modified, by PL 100-180 when non-disadvantaged SBs were precluded from bidding follow-on production to in-house programs.
PL 100-180 DTD 1987	National Defense Authorization Act of FY88	<ul style="list-style-type: none"> Revoked authority for set asides to SDBs if item is already bought from SB or 8(a). Authorized \$10 million study of barriers to woman-owned business. 	<ul style="list-style-type: none"> In-place. Significant controversy between Small Business caucus and the Black and Hispanic caucus.
PL 100-590 DTD 1988	Small Business Administration Reauthorization	<ul style="list-style-type: none"> Breakout procurement center reps can appeal PCO decisions to service secretary. Added attention for rural small businesses. 	<ul style="list-style-type: none"> In force. Impact spotty.
PL 100-656 DTD 1988	Business Opportunity Reform Act	<ul style="list-style-type: none"> Added competition to 8(A) programs over \$3m/\$5m. Liquidated damage assessed for failure of large business to try in "good faith" to meet 5% goal. All Federal agencies buy 20% from small business, 5% from SDBs. Test program with no set asides. 	<ul style="list-style-type: none"> In place, but "Liquidated Damage" provision not implemented due to "Good Faith" enforcement problems (litigation concerns). Test program without SB set asides still has same small business success record as with set asides.
PL 100-442 DTD 1988	Amendment - Indian Refinancing Act	<ul style="list-style-type: none"> 5% incentive to large business to subcontract to Native Americans. 	<ul style="list-style-type: none"> Not implemented because the value of the 5% provision was not funded.
PL 101-165 DTD 1990	DoD Appropriation for FY90	<ul style="list-style-type: none"> Authorized \$8 million to pay for incentives in 100-442. 	<ul style="list-style-type: none"> No funds were appropriated.
PL 101-189 DTD 1990	National Defense Authorization Act of FY90	<ul style="list-style-type: none"> 5% SDB goal extended to 1993. Guidance for Native American contract performance recording for reservation work. Directed 30 8(A) construction contracts from DoD in 90/91, waiver of bonds. Test case for DoD-wide total company subcontract plan. 	<ul style="list-style-type: none"> In force. Construction contracts not awarded because SBA would not waive surety bonds. No DoD-wide subcontract plans - too much work, with no reward.
PL 101-510 DTD 1991	National Defense Authorization Act of FY91	<ul style="list-style-type: none"> \$25K threshold for small purchases (up from \$10K). Authorized major system pilot program with some legal provisions waived. Promoted SDB + 1 agencies. Established Mentor-Protege program. 	<ul style="list-style-type: none"> In force. No major pilot project. Mentor-protege still being defined for implementation regulations.

• There will be continued pressure to improve the opportunities with DoD for Small Business and Small Disadvantaged Business (SB/SDB). If more systems contracting means fewer prime awards to SB/SDBs, the command can still ensure that total dollar participation (prime and subcontract levels combined) by Small and Disadvantaged Businesses does not decline. Provided that maximum best effort in this area is expended and recognized, the Army, and AMC then have the option of reallocating the prime contract goals for AMCCOM as appropriate.

- Such social goals are reasonable, provided that compliance does not interfere with the primary missions of the command or drive up costs.

- When goals are established, they should be tracked and enforced more rigidly, including incentives and penalties.

Although there is general consensus that costs of these SB/SDB programs impact the total DoD acquisition budget by 15% to 30% (former Assistant Secretary of Defense, Lawrence Korb, conservatively estimated a \$10 billion price tag for such purposes²), the majority of decision-makers still believe that reasonable application of such goals to DoD spending is appropriate.

Additionally, there are small contractors who prefer to subcontract to industry rather than the Government, due to the relief from the administrative burden that a systems contractor can provide. For example, one former "Minority Subcontractor of the Year" now refuses to apply for 8(A) prime opportunities, preferring to work as a key, high quality, subcontractor to a major ammunition prime. The SBA 8(A) application process is very costly and time-consuming for a small start-up company to go through. The basic eligibility statement, SBA Form 1010B, is 20 pages long. The personal eligibility statement is another six pages, with another ten pages of certifications and business plan information required. The SDB subcontracting emphasis of the new 1991 Mentor-Protege Program (Public Law 101-510) could help AMCCOM substantially in upgrading SDB participation, due to the multiple goal credits it allows for prime contractors who provide intensive support to emerging SDBs.

Government is sometimes limited by protocol in how it deals with other government organizations. Industry can deal directly with all of the SBA, and influence the direction of various rulings through Congress and other federal agencies to ensure achievable and realistic goals and directives.

There is substantial opportunity for system primes to work with subcontractors, the Small Business Administration, and the appropriate committees in Congress. This would ensure that both AMCCOM direct and indirect contributions to improvement of opportunities for SDBs are recognized and maximized, in the context of the Command's overriding mission to supply ammunition.

Conclusions

With regard to the acquisition, legal and political environment, we can conclude the following:

- Acquisition regulations (particularly "Best Value" evaluations, CICA, and SDB "Mentor-Protege" efforts) will continue to be compatible with industry systems contracting, with the subordination of price/cost evaluations and competition to readiness as the first objective.

- Political pressures supporting industry system contracting will increase as declining dollars force down-sizing of the sustainable government ammunition base, and the flexibility of "out sourcing" grows in desirability.

² Hiatt, F. and R. Atkinson, "To the Pentagon, Oversight has Become Overkill", *The Washington Post*, 4 July 1985.

Recommendations

Based upon the above analyses and conclusions, we offer to the U.S. Army the following recommendations:

- The U.S. Army should continue to emphasize MOB base readiness over all other procurement factors, and should make procurement awards based on "Best Value" rather than cost alone.
- The U.S. Army should consult with industry and trade associations when political influences which are contrary to readiness needs threaten to disrupt the base. The Government-industry partnership is critical to maintaining a viable ammunition capability.
- The U.S. Army should buy ammunition from systems contractors, and rely on them to assist with meeting goals for SB and SDB socioeconomic programs through creative, proactive "mentor" subcontracting.

4.1.3 Product Management, Requirements, and Improvements

The objective of this section is to describe the advantages which accrue to the Government in using industry systems management more extensively for product management of howitzer ammunition programs. A corollary objective is to discuss the advantages that industry systems management may offer the Government in terms of meeting product requirements and implementing product improvements.

From an industry perspective, the best managed and most successful ammunition programs occur when the Government program management authority, the Government laboratories and product procurement agencies involved, and the industry participants contracted by the Government work together as a team.

The product management process enables the Government to meet its program objectives. This process is optimized when the Government decides, at the beginning of the product life cycle, to contract for a capable industry systems manager to join their team. The industry system manager can best utilize the combined government and industry resources to accomplish the program objectives because industry will invest valuable resources early if believes that it can contribute directly and managerially to program success and reap financial rewards accordingly. Additionally, when the industry system manager participates fully in the product requirements definition process, that contractor can contribute more directly to the product improvements process.

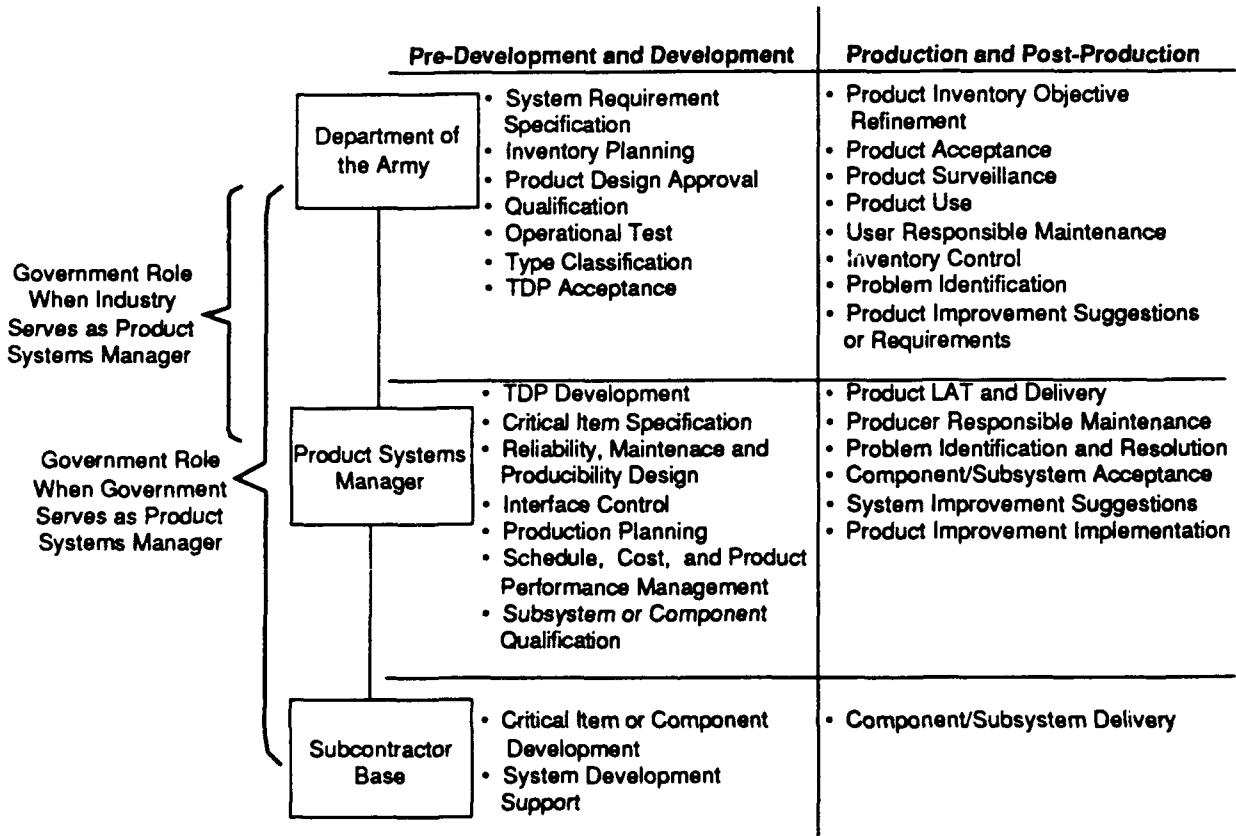
The remainder of this section addresses Product Management, then Product Requirements and Improvements. Background, trends, and analyses of subordinate issues are presented separately, then a combined set of conclusions and recommendations is provided.

Product Management — Background

Figure 4-6 shows how roles and responsibilities for product management differ depending on whether Government or industry manages the product development and production effort.

Historically, both Government and industry have maintained program managers, ammunition specialists, laboratories, and production facilities. To the extent that it is affordable, this process and state of affairs is beneficial. As retention of full government and industrial capabilities becomes less affordable, it becomes imperative to minimize duplication of government/industrial activity. This means developing or reinforcing a shared government/industry trust to accomplish the necessary life cycle tasks with minimal redundancy.

As ammunition product developments have incorporated and applied advanced technologies, and as industry has invested in developing advanced technologies which these products utilize, there has been a trend toward greater utilization of industry as a system manager simply because of industry's knowledge base. This has been the case in the aircraft and missile business and to a lesser extent in the howitzer and other ammunition business areas.



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Figure 4-6. Government and industry systems management responsibilities

Both Government and industry have demonstrated successful system management capability. For example, medium caliber (GAU-8/A, Lightweight 30mm, 25mm Bushmaster, 20mm M-50 series) and tank ammunition (105mm, 120mm) product life cycles have been successfully managed both ways. Since the future trends will force us to "do more with less," we must proceed to establish more effective use of potentially synergistic resources available to both Government and industry.

In these instances, the Government has been moving toward greater reliance upon and acceptance of industry to fill the systems management role on ammunition programs. Typical candidate programs can be characterized as 1) those with a large subcontractor network which benefit from a single systems integrating manager (120mm); 2) those which utilize advanced technology and/or advanced manufacturing processes (SADARM, STAFF); and 3) those with special challenges, such as tight schedules or international technology transfer.

Product Management — Trends and Analyses

To describe potential advantages to the Government of industry systems management, we have structured the following discussion around the following product management drivers: concept definition, project planning, project staffing, product partitioning, cost and risk management, and TDP management.

Concept Definition. On industry-managed programs such as 120mm tank ammunition, GAU-8/A, and others, both Government and industry have played important roles in the concept definition phase of the product cycle. On GAU-8/A, the Air Force customer specified only form, fit, and function requirements, and let their competing system contractors evolve and define their own concepts for the family of 30mm rounds developed for the A-10 aircraft. To this day, with nearly 100 million rounds delivered, the Alliant Techsystems and Aerojet rounds meet the same form, fit, and function requirements but are built from different technical data packages. In production since 1974, GAU-8/A has enjoyed a steep 85 percent learning curve and exceeded Air Force expectations for cost and delivery. The GAU-8/A systems level competition resulted in each contractor striving to improve the ammunition rounds to make them more producible, and, therefore to improve market share. In this case the Government competed two systems contractors, gave them design and process freedom, and benefited greatly at the cost line, approximately 50% less than the originally estimated unit product cost.

The Army's 120mm tank ammunition program has used multiple methods of concept development. The program originated with German 120mm technology and a German technical data package. To meet the original fielding imperative (as discussed in section 4.2.3 of this report), the initial technical transfer approach was "to make the rounds like the Germans do"—this was done to minimize design changes and related schedule disruptions and worked very well to establish the baseline M830, M831, and M865 rounds.

Performance enhancements were required for the 120mm M829 round that were not available in the German concept for the kinetic energy round. Here the Army assigned the Ballistic Research Laboratory to do the design concept and initial development of the XM829 round. When the concept was proven by BRL, the design was turned over to the industry systems contractor (Alliant Techsystems) to finish the full scale development, type classification, and production of rounds. This approach also worked very well, and provided a classic example of government/industry cooperation, synergism, and accomplishment.

Still another approach was used on the 120mm M829A1 round. Here the Army program authority, TMAS, turned the concept basically over to Alliant Techsystems as systems contractor. TMAS supported the development effort by assuring rapid government responses for funding, facilities, and personnel where required to enable the systems contractor to develop and manage the new ammunition round. This development and fielding effort was very successful, and provided another example of government/industry cooperation involving industry systems management.

Project Planning. For ammunition programs, project planning has also been accomplished many different ways with industry systems management. In the GAU-8/A program, the Government established key milestone dates such as IOC, but basically took a hands-off approach with the system contractors, Alliant Techsystems and Aerojet. During the development-to-IOC cycle, the Air Force delegated ammunition responsibility to the gun's prime contractor. The gun prime had to qualify two ammunition prime subcontractors. The gun prime took a hands-off approach with its ammunition subcontractors, except for key milestone dates. This approach worked very well, and the program was very successful. The key to its success was that the Air Force and the gun prime contractor, General Electric, had great confidence in their ammunition prime contractors and made them full team members for the A-10 program. Also, associate contractor agreements were signed between airframe, engine, gun, and ammunition primes to enable rapid resolution of A-10 system problems as soon as they surfaced. The GAU-8/A program demonstrated that program planning is best performed by whoever must do the work.

Project Staffing. Industry system management offers great flexibility in this area. Because of its readily redeployable workforce, industry can provide or supplement the government staffs very rapidly. Industry systems management offers an effective alternative to government systems management, especially if the Government must transition to a reduced workforce. (Reference section 4.1.1 for a more complete analysis of workforce reductions on ammunition procurement.)

Product Partitioning. At various levels of the system within which the product is used, the Government does the partitioning. Normally the top level system authority performs this function. The key to success here is that there is close cooperation at the system interface level between system contractors. This was exemplified between TACOM-TMAS and Alliant Techsystems on the M1A1/120mm program, and between the Government and system contractor program manager on the A-10/GAU-8/A program. The latter made good use of associate contractor agreements to minimize finger pointing and to enhance teamwork.

Schedule Management. (Refer to detailed discussion in Section 4.2.3).

Cost and Risk Management. Both Government and industry use similar techniques to manage cost and risk, with varying degrees of success. One of the best cost management tools is the government-validated Cost/Schedule Control System (C/SCS), which is commonly used in the aerospace and defense industry to manage costs and is required on many cost-type contracts. Validated C/SCS systems are primarily available at the system prime level, not at the component vendor level.

Risk management takes many different forms which vary among government agencies and within industry. Since industry must ultimately make a return on any investment, system contractors have an added incentive to evaluate and mitigate financial risks on any program. Government benefits directly

from this practice and can demand that the industry systems manager insert risk assessment and mitigation plans for negotiation into the basic contract framework.

The Government is equally concerned with cost and schedule risk, which translates into a financial concern and capability concern downstream. Thorough pre-planning and continuous risk assessment accompanied with appropriate risk mitigation activities are part of smart product management, and both the Government and industry have good techniques for managing risk. Synergy between the two offers the best risk management possibilities.

Technical Data Package (TDP) Management. The problem of assuring fully producible ammunition when the technical data package is committed to full scale production is very complex. Industry systems management is being used more and more as advanced technologies are applied to ammunition programs. Whether industry or the government manages the TDP development, this area is one that can be improved by the application of smarter development and testing techniques that are currently being used.

These techniques are typically more available and prevalent in usage among system contractors, because they save cost and industry profits from cost reduction. The 120mm ammunition program for example, made use of Taguchi techniques in design of experiments. Proper application provided an enormous amount of data for modest expenditures of funds. Both the M829A1 and M865 round improvements have been realized using these techniques. Because of the TDP's criticality to the product requirements definition process, we have deferred further discussion of TDP development and control to the next subsection.

Product Requirements and Improvement — Background

Table 4-6 shows that a variety of issues contribute to the development of ammunition product requirements. The requirements documents noted in the table reflect how these various issues are resolved. The TDP represents the detailed requirements for procuring a product, not necessarily the detailed requirements for manufacturing a product. Learning how to build the product—and applying this knowledge to solve the inevitable changes—is the primary responsibility of the systems contractor. As shown in Table 4-7, the production TDP captures performance attributes, design attributes, any unique manufacturing equipment that is necessary, process and quality attributes, and product delivery requirements.

What is not included in a TDP is often more critical than what is included. As shown in Figure 4-7, three missing elements in a TDP are linkages, experience, and techniques. These missing elements are what the systems contractor (whether government or industry) provides. The systems contractor understands what the inter-relationships are between the various subsystems (linkages); remembers what works and doesn't work (experience); and has developed the routine, non-critical integration processes for manufacturing, inspecting, and testing the final ammunition product (techniques). The systems contractor applies these three elements in formulating improvements to the TDP.

The necessity for ammunition improvement derives from a variety of factors, as shown in Figure 4-8. Improvements are undertaken to solve a requirement shortfall (an undesired situation with varying degrees of cost and schedule impact) or to implement a beneficial suggestion (a desired situation).

Table 4-6. Product requirement issues and associated support documents

	Pre-Development	Development	Production	Post-Production
Issues	<ul style="list-style-type: none"> • Threat • Current User Capability • Doctrine and Tactics • Technology Base • LCC 	<ul style="list-style-type: none"> • Threat Change • Capability of Technology Base to Meet Needs • LCC 	<ul style="list-style-type: none"> • Threat Change • Product Improvement Needs • U.S. Inventory Objectives • Foreign Product Needs • Training Needs • Product Surveillance • LCC 	<ul style="list-style-type: none"> • Threat Change • Inventories • Service Life Extension/Demil Options • Product Surveillance
Requirements Documents	<ul style="list-style-type: none"> • O&O • ROC (Initiated) • Justification for Major System New Start • Formal Trades and Analyses 	<ul style="list-style-type: none"> • ROC (Final) • Type A and B Development Specs • Product Spec • Process Spec • TDP Development • DTUPC Tradeoffs 	<ul style="list-style-type: none"> • TDP Production • War Reserve Plan and Congressional Budget • Training SOP • Product Acceptance Criteria (Contract) 	<ul style="list-style-type: none"> • Inventory Objectives Documents • Training Draw-down Requirements

Table 4-7. Government/industry TDP development benefits

TDP Approaches	Benefits Realized by:	
	Government	Industry
TDP Developed and Controlled by the Government	Government retains absolute product design control (and performance responsibility)	Build to print manufacturing industry not accountable for product performance
TDP Developed by Industry and Controlled by the Government During Production	Government retains engineering change proposal (ECP) approval authority	Provides industry systems manager with development flexibility to benefit from improved practices such as concurrent engineering
TDP Developed and Controlled by Industry	Government focuses attention on inventory objective planning and control	Increase industry systems manager flexibility during production to introduce engineering changes focused on cost reduction, reliability enhancement, or performance improvement
Form, Fit, and Function Specification TDP Approach	Government focuses attention on inventory objective planning and control	<p>Increase industry systems manager flexibility during production to introduce engineering changes focused on cost reduction, reliability enhancement, or performance improvement</p> <p>Incentivizes industry systems manager to innovate and promote VECPs because selected contractor and Government reap the savings (not competitors).</p>

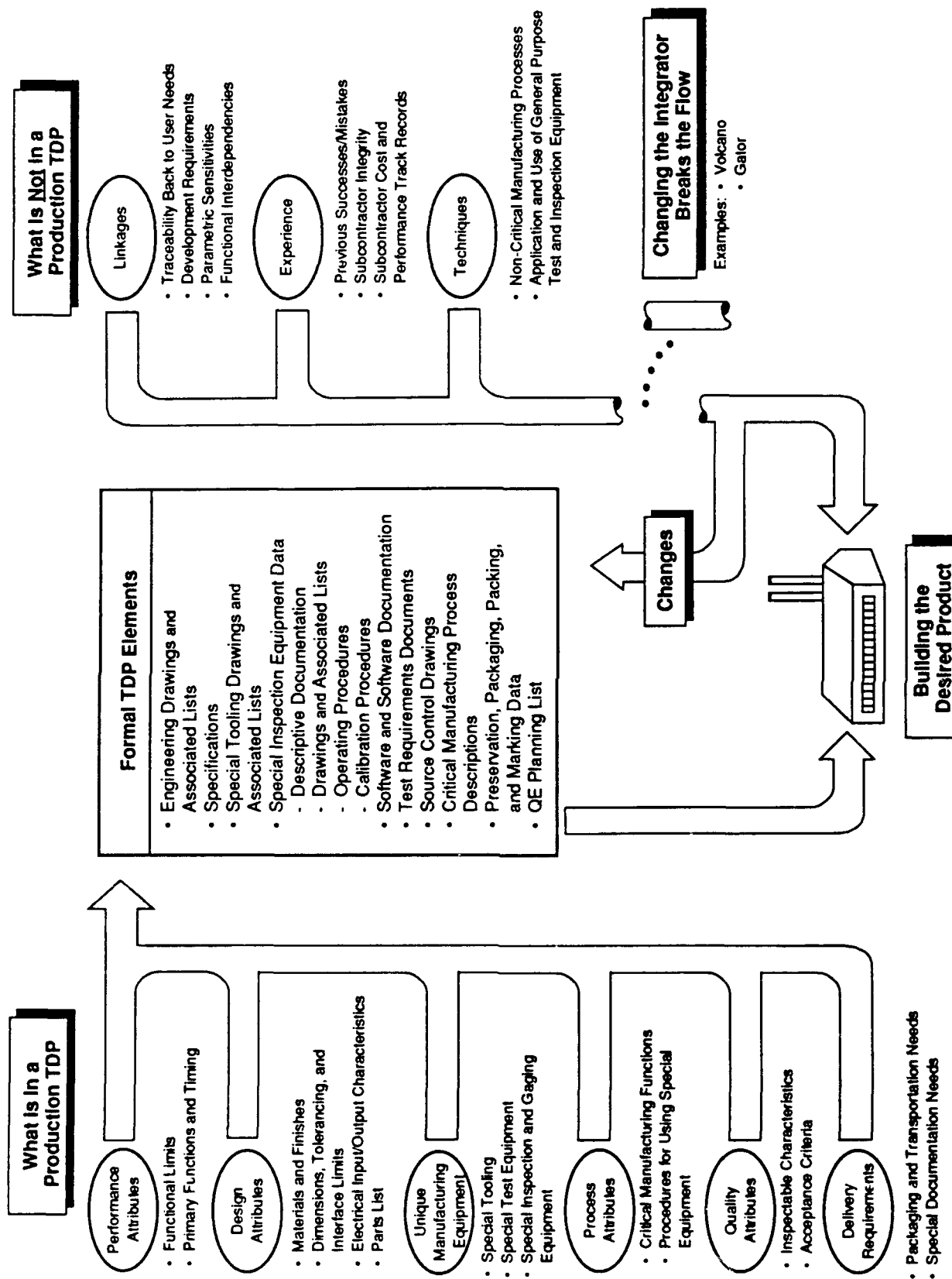
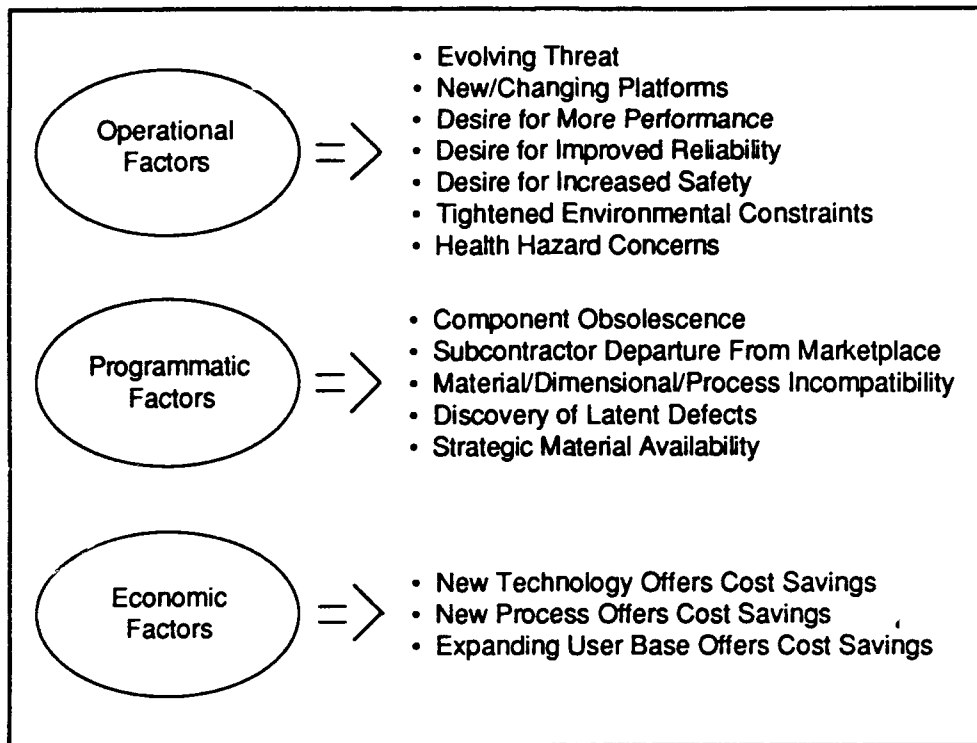


Figure 4-7. Technical Data Package (TDP) elements

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Figure 4-8. Operational, programmatic, and economic factors driving ammunition product improvements

The current Value Engineering Change Proposal (VECP) process is used to implement beneficial suggestions. Modifications to existing product requirements are the means by which improvements are described, evaluated, negotiated, and implemented.

Improvements are inevitable and often desirable. As noted in Figure 4-8, many of the factors driving ammunition product improvements lie completely outside the control of the program: evolving threats, changing platforms, new environmental or health hazard constraints, and availability of strategic materials. Other factors, such as component obsolescence and subcontractor departure, are only partially under the control of the program.

Some improvements can be planned and made part of the product acquisition strategy. The P³I approach makes it possible to develop and field a new round of ammunition, while improvements to the round are being developed for phased integration. P³I affects design strategy by requiring:

- A modular design approach
- A logical tie-in with TQM emphasis upon continuous product improvement
- A carefully architected set of interfaces
- Explicit provisions for space, weight, and electrical power reserves and margins.

The responsibilities of the system integrator can increase significantly in a P³I program. As the phased integration is undertaken, the systems integrator must apply the same undocumented factors described previously — linkages, experience, and techniques — for the integration tasks to be successful.

The function of the Government in the product requirements and improvements process can take two basic forms depending upon acquisition strategy:

1. Approval (industry systems contracting)
2. Preparation, approval, and configuration management (government systems management).

In the first option, the Government tasks industry to prepare and maintain the product TDP, to draft potential improvements, and to forward them for government evaluation and concurrence; and also to perform standard configuration management functions. The Government acts as a top-level product manager and holds the industry systems contractor responsible for swiftly resolving all product problems. In the second option, the Government is solely responsible for the integrated product requirements and improvements process and must resolve all product problems using its own internal resources or those of a third-party support contractor.

Product Requirements and Improvements — Trends and Analyses

As the diversity and complexity of howitzer ammunition technology increases, the number and complexity of the product requirements will increase. Formal TDPs will increase in size, technological content, and complexity. The number of TDP improvements to be developed, evaluated, and implemented will rise accordingly. The demands on the howitzer ammunition systems contractor will certainly increase over present levels: more functional interdependencies and more interfaces to define, more subcontractors to manage, more integration techniques to master, more problems to solve.

Unfortunately, these demands on the howitzer ammunition systems community will occur simultaneously with demands to reduce government manpower, as described previously in Section 4.1.1. The ability of the Government to conduct the product requirements and improvements process as a systems manager will be under severe manpower constraints by 1995.

As we transition to even greater reliance on industry for product management, placing greater TDP control authority with industry can enhance system management flexibility. This will also require greater industry accountability as well as the associated liability which should be recognized in contract negotiations to assure risk/reward parity. To summarize these approaches, we have constructed Table 4-8 which indicates the advantages of both government and industry systems management for TDP development.

Even without manpower constraints, Government and industry have different resources in approaching potential improvements, as summarized in Table 4-8. Both government and industry integrators will strive to meet user needs. Industry systems contractors, however, will consider improvements from a profit standpoint, balancing risk with opportunity. Beneficial suggestions will be particularly attractive to an appropriately incentivized industry systems contractor, since they offer an opportunity for increased profits by sharing savings with the Government.

In terms of the organizational resources that can be brought to bear on product improvements, industry systems management has several advantages over government systems management:

Table 4-8. Resources for product improvements

Potential Product Improvements	
Type 1: To Solve a Requirement Shortfall	
Type 2: To Implement a Beneficial Suggestion	
Resources	
Government Systems Integration	Industry Systems Integration
<ul style="list-style-type: none"> • Service and National Labs • Project Support Staff • Only Those Subcontractor and Vendors Willing to Accept Government Contracts • Only Those Consultants Willing to Accept Government Contracts • PEP Funds (Type 2 Only) • Limited Contacts • Limited Contacts • Reward and Recognition of Outstanding Efforts 	<ul style="list-style-type: none"> • Service and National Labs • Any Corporate Staff • Broad Spectrum of Subcontractors and Vendors • Broad Spectrum of Consultants • Investment Capital (Types 1 and 2) • Cross-Fertilization from Other Services • Incorporation of Off-Shore Technologies • Reward and Recognition of Outstanding Efforts

- Within industry, any corporate employee can be brought to bear on an improvement effort. Within the Government, significant difficulties can be experienced in getting help from outside the immediate branch or command.

- The full array of subcontractors, vendors, and consultants can be tapped by industry for a product improvement; not all companies and individuals will accept government contracts directly.

- Industry can apply investment capital to resolve necessary improvements and pursue beneficial improvements; the Government is generally limited to the budget at hand for implementing necessary improvements, and must seek PEP funds from external government organizations for beneficial improvements.

- Industry can arrive at business arrangements with foreign firms offering useful product improvement technology far easier than the Government can.

The amount of time that passes between problem detection and problem resolution is influenced in part by the motivation of the systems manager. Responding to potential profit impacts, industry systems contractors are motivated to swiftly identify problem causes and corresponding product improvements. The greater the potential profit impact, the greater the motivation to implement a solid improvement in the shortest amount of time.

Industry systems contractors and the Government can both develop and manage product improvements, but the degree of government risk exposure can increase significantly when the Government acts as the systems integrator. As summarized in Table 4-9, the risk to the Government varies with the causes behind a product improvement.

When the acquisition strategy is industry systems contracting, the Government expects industry to assume most of the program risk. When a problem arises, industry is expected to fix it (with government concurrence). The Government routinely seeks data and product warranties as part of this risk shifting. When government systems management is the acquisition strategy, the Government assumes virtually all program risk. When a problem arises, the Government has no recourse but to fix the problem itself with the resources available.

In the area of howitzer ammunition, for example, the Army has an historic role as the keeper of corporate knowledge and technical memory. Transition of product management responsibility to industry would include government lab experts on any post-development action teams established to deal with

Table 4-9. Government risk with various product improvement causes

Product Improvement Rationale	Government Risk	
	Industry Systems Contracting	Government Systems Management
Unanticipated Material/Dimensional/Process Incompatibility Problems During Integration: Everything Meets TDP but Product Unsatisfactory	Prime Contractor Fixes Problem	Government Must Identify Cause(s), Fix TDP, Negotiate Impacts
Subcontractor Departure From Industry or Market	Prime Contractor Fixes Problem	Government Must Find New Subcontractors
Component Obsolescence Threatens Cost and Schedule	Prime Contractor Fixes Problem	Government Must Redesign Product, Fix TDP, Negotiate Impacts
Strategic Material Availability Concern	Prime Contractor Fixes Problem	Government Fixes Problem
Discovery of Latent Product Defect	Government can Seek Warranty Remedy from Prime Contractors	If Defect Cause can be Established, Government can Seek Warranty Remedy from Subcontractors
New Technology/Process Offers Cost Savings; Investigated and Successful	Prime Contractors Recovers Investment and Shares Savings with Government	Good Use of PEP Funds
New Technology/Process Offers Cost Savings; Investigated and is not Valid	Prime Contractors Loses Investment	PEP Funds Wasted

production problems and field support. This type of partnership for the longer term has the Government utilizing expertise wherever it exists, but maximizing industry accountability.

Industry systems contractors accept that risk comes with opportunity and that risk cannot be eliminated, particularly with high technology products. Being motivated by profit, industry systems contractors implement formal "risk mitigation" and "risk management" techniques. Industry systems contractors are particularly alert to the risk associated with their choice of subcontractors, and are not adverse to awarding contracts to someone other than the low bidder if the program risk is unacceptable.

Conclusions

With regard to product management and the associated product requirements/improvements process, we can conclude the following:

- **Concept Development** — Industry systems management provides the U.S. Army a broader range of ammunition design concepts through competition. This takes advantage of the technology base existing across the defense industry (on-shore and globally), as well as commercial component technologies available to the industry system manager.

- **Project Planning** — The U.S. Army is always responsible for establishing key milestones, but industry adds greater flexibility to plan program details because industry system contractors can take advantage of both government and industry support facilities to reduce program risk and schedule barriers.

- **Project Staffing** — Industry provides greater flexibility to staff programs with appropriate personnel because its hiring practices are not as regulated as those within government. The reality of manpower reductions is forcing the U.S. Army to rely more upon industry to staff ammunition programs.

- **Product Partitioning** — The U.S. Army is best equipped to partition their overall procurements into meaningful system contracts where well-defined interfaces exist because it normally retains ultimate product/program responsibility.

- **Technical Data Package Management** — Industry is highly motivated to develop a TDP that is traceable, producible, reliable, supportable, and provides the performance needed to satisfy user needs because their profitability depends on those attributes of the TDP. Future stability and success of an industrial systems contractor is very dependent on producing, maintaining, and improving TDPs which support smooth transition from development hardware to production hardware.

- **Schedule Management** — Industry system management is more flexible than government systems management, and therefore can reduce schedules significantly by advance releasing funds and using industry facilities to supplement those available in Government.

- **Cost and Risk Management** — Industry is highly motivated to pursue investments that complement their business base, reduce program risk through the pursuit of backup options, and promote their general business success. Motivated by profit concerns, industry system contractors continuously manage risk throughout the product development cycle to reduce potential cost and schedule impacts.

• **Product and Risk Management** — U.S. Army resources to develop and implement product requirements and improvements are clearly decreasing. Industry systems management can offload government resources. Motivated by profit incentives, industry system contractors can ensure timelier implementation of beneficial product changes.

Recommendations

Based upon the preceding analyses and conclusions, we offer the U.S. Army the following recommendations.

- The U.S. Army should use industry systems management to generate more ideas for ammunition concept development.
- The U.S. Army should specify milestones, and allow industry systems managers to do the detail planning.
- The U.S. Army should select industry systems managers early in the product life cycle to allow their staffing, investment, and facilities planning and implementation to be utilized to improve program success.
- The U.S. Army should utilize industry systems managers to develop and maintain howitzer ammunition product requirements.
- The U.S. Army should continue its present policy of appropriately incentivizing industry systems managers to seek potential beneficial product improvements.
- The U.S. Army should maximize cooperative utilization of government and industry expertise through cooperative IR&D, long-term partnerships, personnel exchanges, and joint action teams to resolve post-development problems.

4.1.4 Technology Base

The objective of this section is to answer this question: How does the U.S. preserve its ammunition technology base in the face of a declining budget, reduced government and industry workforce, and a down-sized military industrial complex? By answering this question in terms of certain operational, external, and domestic factors, we can assess how the U.S. defense technology base for howitzer ammunition can best be served through industry systems management.

The base is comprised of people, institutions, technical knowledge, experience, and production capabilities used to develop and manufacture the defense equipment needed to achieve national security objectives. The base consists of three functional elements: the technology base, the production base, and the maintenance base. The technology base consists of government laboratories, private industry laboratories and research facilities, test centers, university laboratories conducting defense research, and the trained scientific and technical personnel that staff these facilities. The production (or mobilization) base consists of private industry and government enterprises for the manufacture of defense equipment (discussed in Section 4.1.5 of this report). The maintenance base consists of government facilities and

private companies that maintain and repair defense equipment. While occasionally excluded in defining the U.S. defense technology and industrial base, the maintenance base is huge: at present, the maintenance base itself (\$10 billion in FY91) would rank among the top 25 U.S. companies in size. (Because this base has been less relevant to ammunition procurement than the technology and production bases, it is not discussed in this report as a study driver. High tech ammunition may require more maintenance attention in the future, however.)

From an industry perspective, the technology base can best be protected by forming a stronger partnership between public and private sector interests. Industry systems management offers several distinct benefits to the Government:

- Sufficient overhead base to allow meaningful IR&D for next-generation howitzer ammunition technologies.
- Critical mass of technical and managerial talent in industry to offload government personnel from micromanagement of technology-driven programs.
- Excellent network of contacts with foreign companies to enable tapping into NDI technologies through tech transfer agreements and FMS sales.

The remainder of this section presents Technology Base background issues, trends and analyses, and conclusions and recommendations which follow from the analyses.

Background

With the sudden, recent changes in East-West relations, the United States is currently undergoing a major reassessment of national security planning. Executives in government and industry realize that if the nation is indeed embarking on the third major demobilization of this century, then serious attention must be given to protecting the defense technology base.

Unlike the general dismantling of the defense base following World Wars I and II, the present situation has two aspects. First, there is a general understanding that a defense capability must be retained to deal with the uncertain future of the new world order. Second, unlike the demobilizations after World Wars I and II, the United States is experiencing unprecedented economic competition, raising serious national security concerns over U.S. technological and industrial capabilities.

As shown in Table 4-10, national security objectives are achieved through the combined efforts of both public and private sector participants. The private sector approaches the defense technology base from the perspective of anticipated business. Investments are made in staff, laboratories, and test facilities with the belief that technology will be advanced and business (sales, profits) will follow in due course. These investments are financed by selling equity shares in the enterprise, borrowing funds in the capital marketplace, and reinvesting money from profits. The public sector component of the defense technology base is driven by national security needs rather than business objectives. Investments in staff, laboratories, and test facilities are made for strategic purposes, and are financed by taxes. Performing scientific research is not a major mission of these facilities; the primary objective of most service laboratories is to support the development and user commands.

The two sectors of the defense technology base operate in a reinforcing partnership. The model followed by most defense laboratories is to have cells of technical expertise that strive to transition

Table 4-10. Elements of the U.S. Defense Base

	Technology Base	Production Base	Maintenance Base
Private Sector <ul style="list-style-type: none"> • Financed by Capital and Profits • Investments Driven by Anticipated Business 	<ul style="list-style-type: none"> • Industry Engineers, Scientists, and Technicians • Industry-owned Labs and Research Facilities • Industry-owned Test Facilities 	<ul style="list-style-type: none"> • Industry Engineers, Foremen, and Skilled Labor • Industry-owned Facilities (COCO) • Industry-owned Equipment 	<ul style="list-style-type: none"> • Industry-operated Depots • Industry-operated Maintenance and Repair Facilities • Field Support Personnel
Public Sector <ul style="list-style-type: none"> • Financed by Taxes • Investments Driven by National Security Needs 	<ul style="list-style-type: none"> • Universities Conducting Defense Research • Government Engineers, Scientists, and Technicians • Government Labs and Research Facilities • Government Test Facilities 	<ul style="list-style-type: none"> • Government Engineers, Foremen, and Skilled Labor • Government Facilities (GOGO and GOCO) • Government-owned Equipment 	<ul style="list-style-type: none"> • Arsenals • Government-operated Depots • Government-operated Maintenance and Repair Facilities

technology into the procurement system. These cells of technical expertise monitor the technology base and often serve as the corporate memory for both sectors. The Government owns many test facilities that are used to evaluate R&D concepts furnished by the private sector; the private sector owns many excellent test facilities that can often be accessed quicker than the corresponding government test facility.

Industry systems contractors frequently develop technology in a project for one service branch and are able to apply a variation of that technology to a subsequent project for a different service branch. Likewise, the defense laboratories supporting a particular service branch are often able to suggest appropriate technological solutions to an industry systems contractor providing a product to another service. This continuous cross-fertilization between defense laboratories and industry is another example of their mutual interdependence.

Weapon developers in both the public and private sectors frequently benefit from subcontractors for technology and innovation. Government and industry systems contractors and their smaller second tier subcontractors all rely on hundreds of specialized firms for materials, components, and technology.

The dependence of defense systems such as howitzer ammunition on "nondefense" technology and civilian firms has always existed. This dependence can become a national security concern, however, when the technology is available only from off-shore sources. The continuing rise of "dual-use" technologies—technologies such as composites, microelectronics, and software that have both a civilian

and a military potential—is another technology base issue, particularly when dual-use technologies are internationalized.

As shown in Figure 4-9, a variety of operational, external, and domestic factors will influence DoD planners in making provisions of the howitzer ammunition technical base. The traditional operational factors, such as the capabilities of the threat and the nature of the armament necessary to meet that threat, are primary drivers, and will remain so. Other factors, such as how much offshore cooperation is acceptable and the degree of technological interdependence that is allowable, are more problematic, and will have to be balanced against a declining U.S. defense budget.

Trends and Analyses

Over the past 20 years, the technology content of howitzer ammunition has increased dramatically. As shown in Figure 4-10, the number of technical disciplines that can enter into the development of future howitzer ammunition will far exceed the technology of conventional howitzer ammunition.

Table 4-11 supplements this figure by tracking the evolution of technology complexity from M107 through RAAM and ADAM to 155mm SADARM. The systems manager for howitzer ammunition—be it Government or industry—must be prepared to integrate all of the technical disciplines shown in this figure and table.

Despite the significant increase in howitzer ammunition technology, the government technical community faces simultaneous pressure for spending cutbacks and manpower cutbacks, as discussed in Section 4.1.1. These decreases in Army civilian manpower are already underway and, if translated

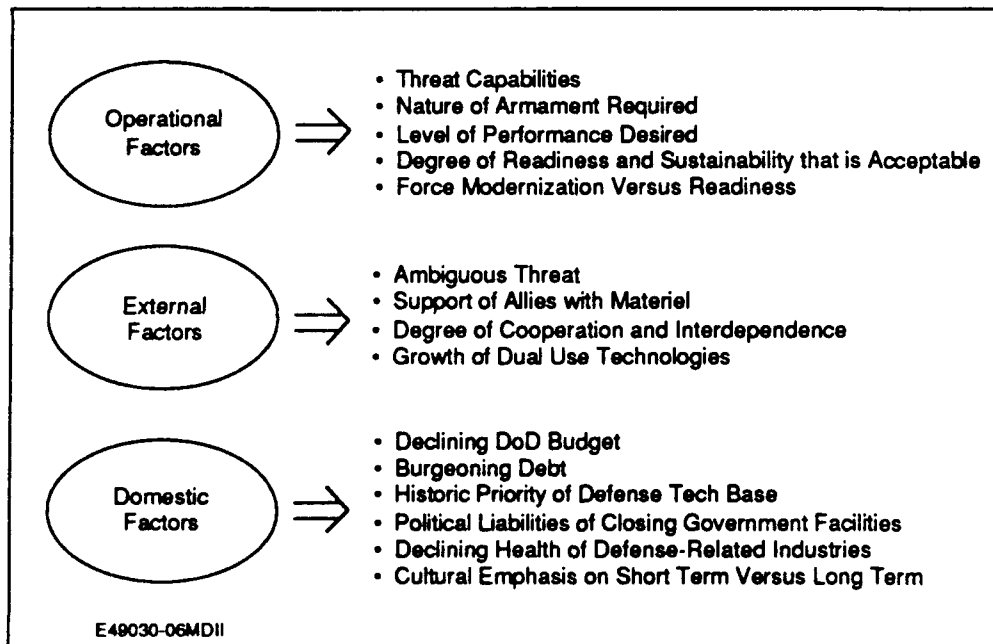
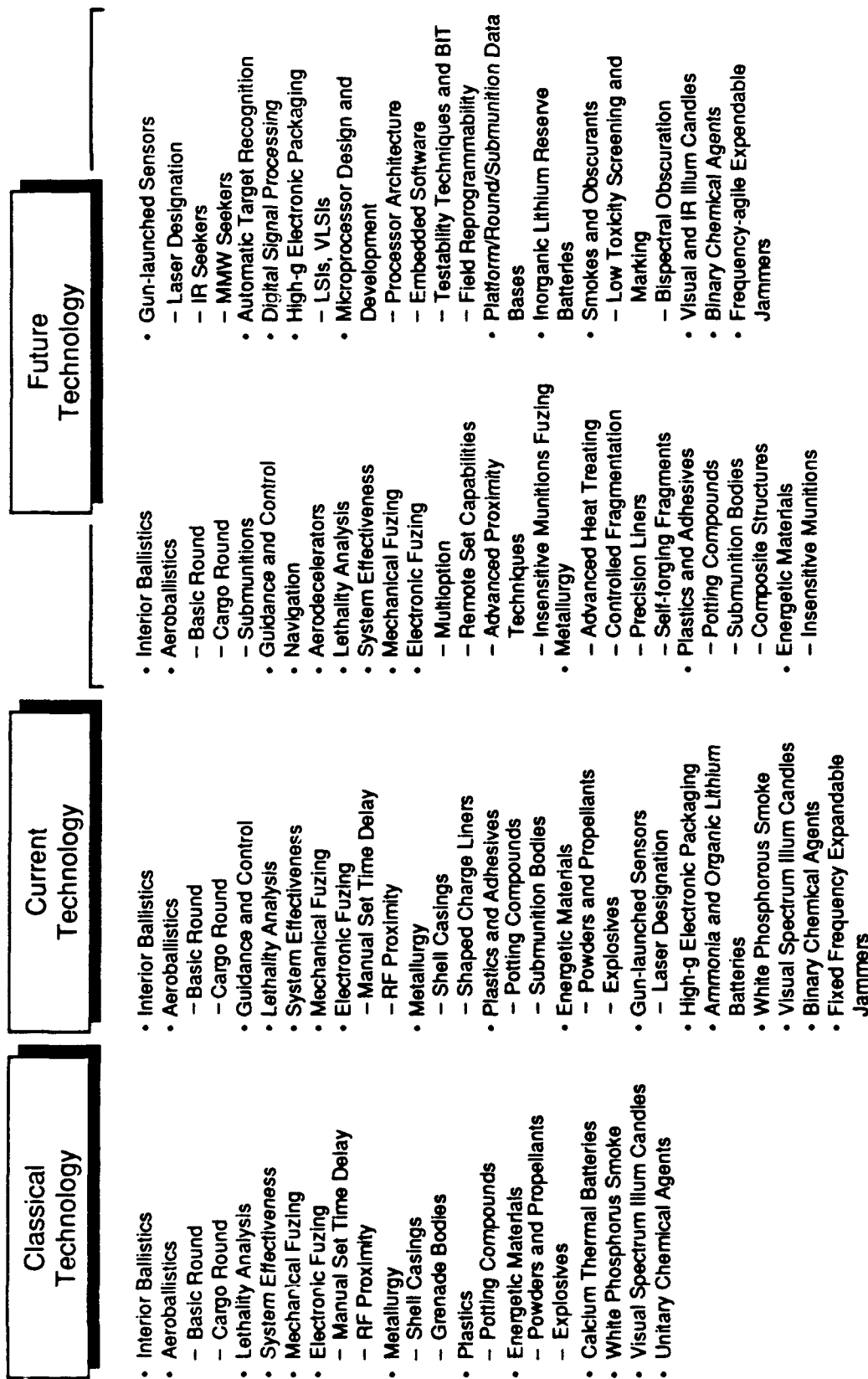


Figure 4-9. Operational, external and domestic factors influencing tech base planners



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Figure 4-10. Evolution of non-nuclear howitzer ammunition technical disciplines

Table 4-11. Evolution in complexity of 155mm artillery ammunition

Ammunition Round	What It Is	TDP Size- Compared to M107 As "1"	Mechanical Complexity M107 Is "1"	Electronic Complexity RAAM Is "1"	Sensors	"Smartness" (Autonomy)
M107	High Explosives	1.0	1.0	N/A	None	N/A
M483 DPICM	Carrier with 88 Dual-Purpose Grenades in Each Projectile	1.5	5.0	N/A	None	N/A
M718/M741 RAAM	9 Anti-Tank Mines in Carrier Shell	2.0	7.0	1.0	1 Magnetic Detector Per Mine, Analog	Target Activated
M692/M731 *DAM	36 Anti-Personnel Mines in Carrier Shell	3.0	10.0	.5	7 Electro-Mechanical Triplines per Mine	Target Activated
Copperhead CLGP	Laser-Guided Unitary Round	20.0	15.0	20.0	1 Laser Detector and/or Process	Command-Guided (Semi-Active)
SADARM (155mm)	2 Smart "Shoot-to-Kill" Submunitions in Thinwall Projectile	25.0	15.0	25.0	Dual-Mode Spectrum, Concomitant Logic, Digital Processing	100% Autonomous

through to decreases in the Army howitzer ammunition civilian staff, will place a tremendous burden on those that remain. With the technology content of howitzer ammunition steadily increasing, the Government should actually be increasing staffing levels accordingly if it desires to continue government systems contracting.

While declining budgets and increasing technological content are directly impacting the government's howitzer ammunition community, another important trend is being seen among defense contractors and suppliers—globalization. Much has been written lamenting the state of the onshore supplier base, no effective measures have been found to halt the decline.

While government systems management has little to no leverage on the international market, industry systems contractors can have some leverage. Industry systems contractors can protect the U.S. technology base directly through sales to foreign nations, and can tap into the international technology base through licensing, co-production, and offset agreements. Bluntly stated, a foreign firm will not furnish technology to enhance the national security of the United States; a foreign firm will sell technology when it makes good business sense to do so.

A variety of related structural changes to the howitzer ammunition technical base are likely to be seen over the next decade. As shown in Figure 4-11, these structural changes range from consolidation of

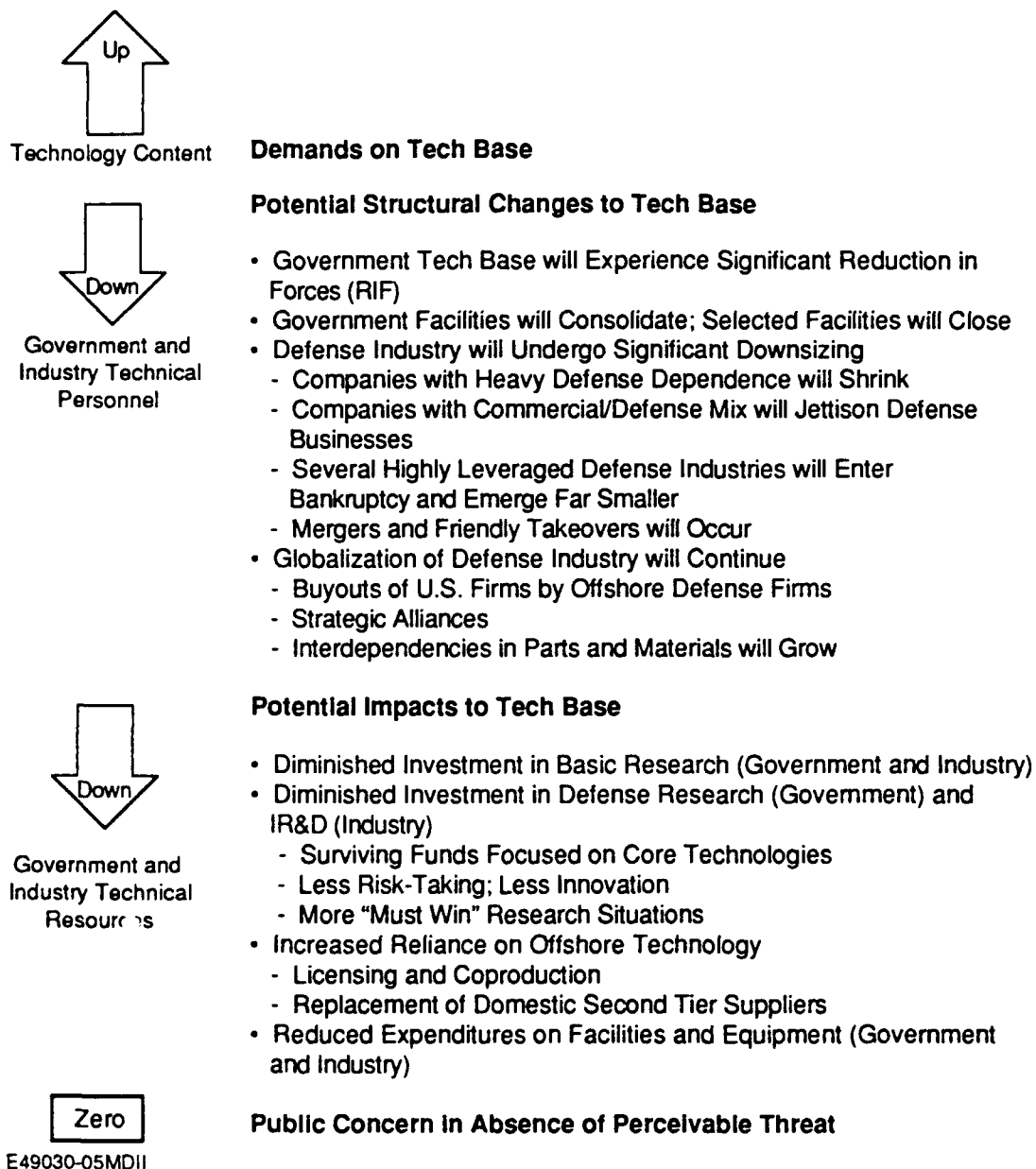


Figure 4-11. Projected state of defense technology base in 2001

government facilities with some closings to a dramatic downsizing of the onshore defense industry. As shown on the same figure, the potential impacts to the howitzer ammunition technology base by 2001 would range from a diminished investment in basic research on the part of both the Government and industry to a reduced expenditure on facilities and equipment.

DoD planners have an extremely challenging task facing them in addressing the future of the U.S. defense technology base. The size and nature of the future technology base must be considered. The timing of changes to the defense technology base must be carefully examined to prevent further damage to government and industry assets and the overall role of the DoD in organizing, planning, and guiding the defense technology base must be thoroughly reexamined.

In charting the course of the howitzer ammunition technology base, DoD planners will have to examine the implications of systems contracting on technology base health. Certain technology base components such as service laboratories and test centers must be viewed as irreplaceable assets in implementing cutbacks. The management challenge will be how to handle cuts in government personnel without jeopardizing the quality of the defense technology base. One obvious option is to utilize industry systems contracting and shift government dollars to preserve the defense technical base rather than on management functions which industry can perform.

Conclusions

With regard to the defense technology base, which is a partnership of public and private sector assets, we can conclude that the use of industry systems contracting provides an excellent means to protect the howitzer ammunition technology base. As dedicated R&D dollars shrink and the remaining funds migrate toward costly smart munitions development, systems contracting for howitzer ammunition and the attendant larger IR&D pool available will be the only reliable way to maintain the base and initiate product improvements for dumb munitions. In addition, industry systems management offers the following benefits:

- Allows the U.S. Army and Government to apply diminishing financial resources towards the retention of irreplaceable technology base assets such as key government laboratories and test centers.
- Relieves government technical base experts from the overwhelming burden of resolving routine programmatic problems, allowing them to focus on advancing the technology.
- Allows the ongoing globalization of the defense technology base to be directed instead of observed. U.S. industry systems contractors have far more flexibility in working with the offshore technology base than the Government.

Recommendations

As the U.S. enters another cyclical retrenchment of the defense budget, the government industry partnership must protect the howitzer ammunition technology base for the inevitable future needs. Some potential U.S. Army and/or U.S. Government actions to preserve and enhance the defense technology

base are listed in Table 4-12. Two related recommendations, which overlap with other sections of this report, are:

- The U.S. Army and the Government should remove structural barriers to foreign sales by industrial systems contractors. Off-shore sales of howitzer ammunition directly assists in the retention of the U.S. defense technology base. (Refer to Section 4.1.6 for more detail.)

- The U.S. Army and the Government should consider a favorable linkage between the evolving contractor certification program and the desire to halt the decline of the onshore defense technology base at the lower tiers. By extending the certification program through industry systems contractors to the subtier suppliers, the Government and the industry systems contractor can mutually provide the subtier supplier a greater degree of business stability than at present. (Refer to Sections 4.1.2 and 4.3 for more detail.)

4.1.5 Mobilization Base (MOB) Readiness

This objective of this section is to answer the question: How does the U.S. preserve its ammunition production base readiness in the face of a declining budget, reduced government and industry workforce, and a down-sized military industrial complex? By describing and evaluating the answers to this question in terms of flexibility, efficiency, and responsiveness, we can differentiate between the two acquisition approaches—government systems management versus industry systems management—and assess whether the U.S. production base for howitzer ammunition can best be served by industry systems contracting.

Table 4-12. Potential actions to preserve and enhance the defense technology base

Category	Action
Partnership	<ul style="list-style-type: none"> • Stress Efficient Use of Remaining Resources <ul style="list-style-type: none"> - Encourage Elimination of Redundant, Underutilized Resources - Discourage Wasteful Government/Industry Competition
Resources	<ul style="list-style-type: none"> • Strengthen Partnership Between Government and Industry <ul style="list-style-type: none"> - Provide Leadership - Provide Management - ADPA a Prime Vehicle
Community	<ul style="list-style-type: none"> • Foster Greater Cooperation Within Community <ul style="list-style-type: none"> - Government/Industry - Interservice - Industry/Industry - Offshore Defense Tech Base
Allies' Participation	<ul style="list-style-type: none"> • Allow Allies to Support Tech Base by Removing Barriers to Offshore Sales (Win-Win-Win Situation)

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As extracted from DOD 4005-3-M, mobilization may be defined as the "act of preparing for war or other emergencies. The process by which the Armed Forces are brought to a state of readiness for war. Includes activating Reserves and assembling and organizing personnel, supplies, and material." Critical to mobilization is the industrial base, "That part of the private and government-owned industrial production that is or shall be made available in an emergency for the manufacture of items required by the Armed Forces."

While industrial preparedness describes the state of industry to produce essential material support to the national military objectives, industrial base readiness capability is often defined by surge capability—"The accelerated, production, . . . to meet contingencies short of a declared national emergency utilizing existing facilities and equipment. Only existing peacetime priorities will be available to obtain materials, components, and other industrial resources necessary to support accelerated program requirements."

From an industry perspective, the MOB base can best be protected by forming a stronger partnership between government planning agencies, GOCOs, and COCOs. In this regard, industry systems contracting offers several distinct benefits to the Government:

- Significant capability to provide IPP planning at the systems level
- Considerable flexibility to respond to evolving readiness goals
- Management ability to direct third-party contracts to GOCOs
- Excellent company-to-company contacts to ensure that FMS sales help shore up U.S. industrial base.

The remainder of this section presents MOB Base background, issues, trends and analyses, and conclusions and recommendations will follow from the analyses.

Background

There are several key issues which impact the mobilization base for howitzer ammunition. Perhaps the most important, however, is the right mix of GOGOs, GOCOs, and COCOs. As shown in Figure 4-12, the U.S. mobilization base for ammunition (including tank, small and medium caliber, howitzer, etc.) consists of a variety of plant types:

GOGO — Government-Owned, Government-Operated, such as Pine Bluff Arsenal.

GOCO — Government-Owned, Contractor-Operated, the bulk of what is frequently referred to as "the base." This includes Army Ammunition Plants (AAP) at Iowa, Louisiana, Lone Star, Kansas, Holston, Milan, etc., which were converted to contractor operation during the fifties, but which are workloaded largely as though they were government in-house facilities. The primary difference from a GOGO is that the production and management workers in the factory itself are not civil servants.

COCO — Contractor-Owned, Contractor-Operated (the standard industry model), which includes firms such as Alliant Techsystems, Aerojet, Armtech, Bulova, etc.

Facilities Utilization Agreements. This is an unofficial new category, which could be called "government-owned, contractor-utilized," though there is no commonly recognized term. An example is

U.S. Ammunition Plants

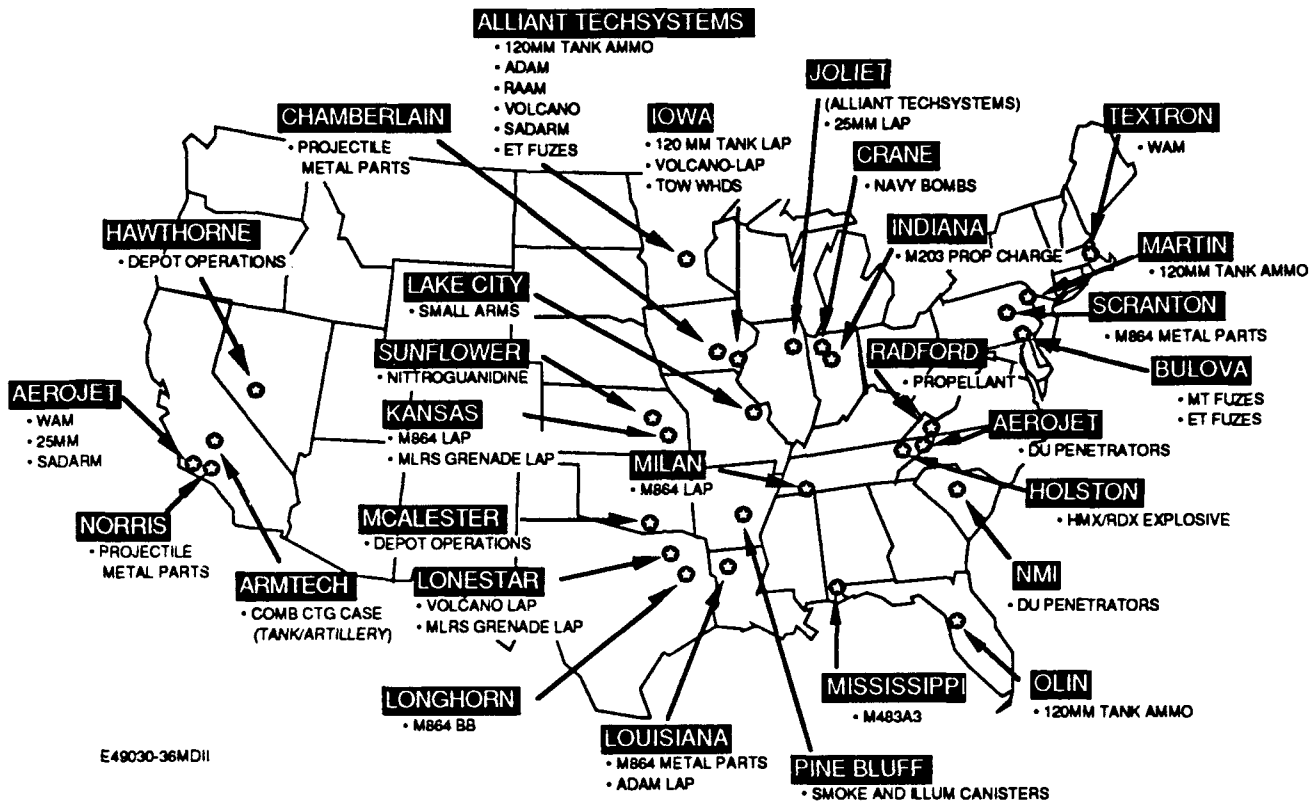


Figure 4-12. GOGO, GOCO and COCO locations (chart prepared by ASARDA, 4Q90)

the Alliant Techsystems occupancy of Twin Cities AAP and Joliet AAP, where plants are officially "inactive" in terms of government GOCO workloading, but where the industry contractor uses the buildings under a facilities agreement with the Army for purposes of competing for contracts. This is the model being proposed for maintaining "warm base" activities with GOCO plants (such as Louisiana, Kansas, and Longhorn) now due to be officially "closed." The operating contractor can compete for prime, "third-party," or foreign production contracts, and is authorized rent-free use of government facilities by AMCCOM.

There is a variety of issues relative to the optimal mix among GOGOs, GOCOs, and COCOs. It appears that all degrees of government control and ownership, from total in-house GOGO production to total industry systems contracting, are compatible with readiness objectives. Pros and cons of these arguments will be summarized in the Trends and Analyses subsection.

Other related Mobilization Base Readiness issues include the following:

Defense Budget Reductions. The DoD budget cuts (refer to section 4.1.1) have resulted in significant decreases to ongoing production programs, not to mention significant delays in IOC schedules, production deliveries, and outright cancellations. Operation Desert Storm created minimal supplemental

budget opportunities, but this is a short-term aberration to the downward spiral of the DoD budget. The critical question is whether the contraction of the base will be well-planned, or will occur on a more ad hoc, laissez faire basis.

Foreign Competition. The international market will also contract in the future. The Europeans and other suppliers will find it difficult to maintain their own defense production bases with the shrinkage of their own domestic markets. Just as in America, a number of European weapons programs are being stretched out and decisions being delayed on a number of "big ticket" procurements. The export market will become even more competitive over the short run and probably over the long run as well.

Foreign Dependency. DoD's foreign source dependence has become a serious and growing problem. Foreign parts comprise only a few percent (by value added) of most defense systems, but their share is likely to rise. Systems now entering service rely on many foreign parts; those on the drawing board rely even more so. Fortunately, foreign source dependency puts DoD at less risk today than before:

- The transportation system today is much better than in WWII
- Key items (ICs, etc.) are smaller and of higher value
- Nations we depend on for parts are generally allies who depend on us.

However, the sources for some critical items are countries whose ties to the U.S. are more tenuous. The integrated circuit suppliers are concentrated in the Pacific rim in nations without long historic U.S. alliances. The MOB base issue for DoD lies in ensuring product and supplier priority in competition with those nations' other customers.

Procurement Policy. Procurement policy changes in the recent past (refer to section 4.1.2) have had the effect of squeezing the industrial base, forcing both the prime and subcontractor base to shrink. These changes are summarized in Table 4-13, along with the impact on contractor capability and willingness to participate in the MOB base. What these changes mean to the mobilization base is that at the very time that its financial strength, stability, and ability to invest is most needed by DoD, the base's ability to respond to these challenges is severely constrained.

Industrial Preparedness Planning (IPP). Industrial preparedness planning is rather uneven. It has been more detailed than it would be if contracting were conducted on a systems-level basis. It has been less detailed or less thorough than necessary to do the IPP job effectively. The Industrial Readiness Directorate has not been staffed to plan at the level which is required for such planning to be totally effective.

Currently, the IR Directorate plans in detail the number and identity of assemblies and purchasing agents who buy the MOB base materials (the "build-to-print" element of the base which is the easiest to start up quickly, or replace). By focusing on assemblies and purchasing agents, rather than on materials availability, Industrial Preparedness Planning is shortchanged, reducing the depth of the MOB base. Systems contractor capabilities are underutilized, while component suppliers who have signed DD 1519 forms are many times all buying their materials from the same U.S. vendor or from offshore.

The new AMCCOM "critical producer" approach recognizes the desirability of an orderly and planned downsizing of the ammunition base, where emphasis is placed on quality and capability to

Table 4-13. Procurement policy changes and their impact on the mobilization base

Policy Issue	Impact on Industry	Consequence for Mobilization Base
Reduced progress payments	Weakens cash flow	Reduces incentive and ability to invest
Completed contract accounting method	Reduces profit and cash flow	Reduces ability to invest
Investment tax credit eliminated	Reduces cash flow	Eliminates incentive to invest
Reduced IR&D and B&P ceilings	Reduces profit and cash flow, requires increased investment	Reduces incentive and ability to invest
Reduced allowability of special tooling and test equipment costs	Reduces profit and cash flow, requires increased investment	Reduces incentive and ability to invest and compete
Ceiling and fixed price options for "out-years"	Increases risk	Reduces ability to participate in MOB
Elimination of economic price adjustment (EPA) "escalation" clauses	Increases risk	Reduces ability to invest and participate
Increased competition (CICA)	Increases risk and investment	Significantly reduces stability and predictability, reduces incentive to improve product and push for quality, reduces willingness to participate
Cost allowability reductions	Reduces profit and cash flow	Reduces incentive and ability to invest and participate
Restrictions on contractor data rights retention	Eliminates competitive advantages of investments	Reduces ability and willingness of "full-service," rather than "built to print" firms to participate and compete
Increased fraud/waste/abuse laws and increased reliance on criminal versus civil penalties	Increased concerns (risks) and costs for all firms who contract with the Government	Reduces number of contractors

enhance readiness, rather than on cost alone. At the same time as these revised evaluation criteria are being developed, there is an opportunity to study which other criteria will contribute most to future MOB capability (i.e., the appropriate level for Government versus industry planning.)

It is no longer possible to meet an analytically derived mobilization production capability based on war-gaming consumption rates, because there is simply not sufficient money to accomplish this. The revised Army MOB readiness goals are to:

- Retain at least one demonstrably viable source for every round used by the armed forces
- Ensure minimum supply available or obtainable to answer any contingency theater need, with enough left over to deter occurrence of other contingencies
- Retain the best mix of government and commercial sources to maximize the number of rounds per ammunition dollar (not the largest number of factories per ammunition dollar).

Trends and Analyses

The top-level strategic trend in the "free world" is toward reduced government ownership of industrial facilities. This is happening both through privatization, where countries like the Netherlands, the United Kingdom, and France, sell their equity stakes in production factories, and through reduced direct facilitization of production. In the 1950s, the U.S. Government held title to 70 percent of domestic military industrial capabilities. By 1963, the figure had declined to 55 percent, and by 1976 it had declined to 35 percent.¹

Table 4-14 summarizes MOB readiness issues by comparing industry systems management with government systems management through breakout procurement. The issues of facilities ownership, competition, assured sources, preparedness planning, accountability, and offshore sourcing are matrixed against a continuum of procurement techniques. Component breakout places a significantly higher administrative workload on the Government, both with regard to actual production (including system management and procurement of GFM materials) and Industrial Preparedness Planning. On the other hand, industry system prime contractors can be held accountable and incentivized to assure readiness, if AMCCOM chooses to take advantage of industry's willingness to assist with these responsibilities. Generally, in the past industry has not been asked or incentivized to take on significant mobilization responsibility beyond single M1519 MOB components.

The remainder of our Trends and Analyses discussion will focus on the critical areas of foreign dependency, IPP, and GOCO role redefinition.

Foreign Dependency. The world economy is becoming more interrelated and global, with very few remaining pockets of insulated, in-country, totally vertical domestic capability. Unless the U.S. Government is willing to abandon its free trade policies and embrace the "industrial policy" favored by Japan and the European Community, there will remain little domestic capability to produce precision optics, package integrated circuits, make heat recuperators, and other items. Nothing AMCCOM, the Army, or even DoD does will change these facts.

Since this globalization of materials trend is unlikely to be reversed, the government/industry ammunition base team needs to step ahead, and decide how to manage assured surge and MOB capabilities (i.e., assured sources of supply) within this "real world" context. Due to the ponderous nature of most government-to-government agreements, it is much more likely that company-to-company strategic support alliances offer an effective means to make the best (most reliable availability) of a suboptimal situation.

For example, a system prime contractor in the U.S. who possesses "wafer" etching capabilities could form agreements with one Pacific rim country-based company, and one Mexican company, to provide chip packaging sources for multiple U.S. end-item products. This would offer geographic dispersal of source availability risk (i.e., in the event of supply disruptions or hostilities). To offer a howitzer example, there are DPICM production suppliers in Europe and Korea which produce the M483 round, and in Germany and Israel which offer improved configurations. The U.S. DPICM prime contractor could have piece part agreements to fill U.S. near-term needs for DPICM components with Netherlands or Korean product content to bring the LAP up quickly and gradually transition to all—U.S. product as long-lead time materials are received.

¹ Gansler, J., *Affording Defense*, p. 363, MIT Press, 1989.

Table 4-14. Industry systems and breakout procurement options and their impact on MOB base issues

Mobilization Base Issue	Procurement Options				
	Breakout Procurement with GOCO Workloading	Breakout Procurement with COCO LAP Workloading	Systems Procurement (GFM, Directed LAP) with Unspecified GOCO	Systems Procurement with GOCOs Specified as Third Party Directed Sub	Systems Procurement with No Directed Sources
Ownership of facilities	Virtually all Government, direct investment (above component level)	Heavily Government	More toward Government, may be balanced	Balanced split	Heavily industry (Government may exercise rights to take title to ST and STE)
Competition	Very intense at component level, nonexistent for GOCO and government system management functions	Very intense at component level, nonexistent for government system management functions	Very intense at system and component levels, moderate to intense for GOCOs	Very intense at system level (if 2 sources), negligible for GOCO	Intense at all levels if 2 sources are supportable by requirements
Assured sources of supply	Maximized for GOCOs and component assemblers, within budget limitations	Maximized for LAP and component assemblers; within budget limitations	Contract provision-dependent	High for LAP, otherwise contract provision-dependent	Contract provision-dependent
Industrial preparedness planning	Maximized for GOCOs, mixed results on components	Maximized for LAP, mixed results on subassemblies, weak on basic materials	Contract provision-dependent	High for LAP, otherwise contract provision-dependent	Contract provision-dependent
Accountability for readiness	All with Government	All with Government	Mostly with Government	Balanced between Government and system primes	Mostly with system primes
Offshore sourcing	Controlled through individual RFP provisions and sources available	Controlled through individual PFP provisions and sources available	Controlled through individual RFP provisions and sources available	Controlled through prime contract provisions	Controlled through prime contract provisions
Example	M483 DPICM, RAAM	2.75" Hydra 70 Rockets	Gator System	120mm Tank Ammunition	Medium Caliber Ammunition

Government regulations are quite compatible with such company-to-company arrangements. Together, the Government/industry team can plan for surge production and industry goals based on world-wide capabilities.

Industrial Preparedness Planning. The recent improvements in IPP after a hiatus in the late 80's are encouraging—FAR supplements 207.103(c) (6) and 207.105(b) (17) now explicitly require—program managers to document an industrial preparedness plan that explains how to accelerate, surge, or mobilize production during emergencies. The Army Industrial Preparedness Manual, AR700-90, is also being updated to reflect the renewed emphasis on industrial preparedness during early acquisition phases. The issue still remains: how can the IPP function be partitioned between Government and its industrial partners in a balanced manner which off-loads planning detail from IR, yet ensures MOB readiness?

IPP planning for industry is not a revenue source. The costs associated with IPP planning are borne in the overhead accounts of the MOB base contractors. For smaller, build-to-print contractors, there is considerably less likelihood that critical resources can be dedicated to these types of "nonrevenue" activities. However, at a higher level of integration, with closely related products, a systems contractor can devote resources in an economical fashion to these contingency needs. Thus, full-service ammunition contractors can support government MOB planning at the system-level much more easily than at the component-level. At the systems level, industry can form a partnership with Government because it has a stake in all of the end item needs: budgeting, appropriations, technical performance, delivery/stockpile, surveillance, and mobilization readiness. By contrast, component-level IPP may, in effect, relieve industry of its accountability to the users to provide product as needed.

GOCO Roles Redefined. There exists an historic tension between industry contractors and GOCO operations. In recent years, more and more GOCO explosives handling and loading plants have been facilitized, providing direct competition between industry and Government for LAP workshare. These investments by industry were made because the international and domestic marketplace dictated that companies must be able to control final assembly of a product to be able to compete effectively. Because GOCO involvement meant that product systems responsibility could be taken away from industry and broken out by the Government, commercial firms established their own LAP operations to maximize their probabilities of retaining the system business. This duplication of facilities has been mitigated somewhat, but not completely, by the third party contracting process. It could be virtually eliminated if the GOCO base were converted to a "facilities contract" arrangement, and systems contractors no longer feared the annual threat of a GOCO third-party agreement being abrogated by a breakout decision.

Remaining issues regarding GOCO roles are: 1) How to resolve the conflict between COCOs who have now facilitized their own LAP capabilities, and face downsizing of the base along with the GOCO plants; 2) How to implement final government decisions on future roles of the single service manager for ammunition, and the GOCOs. The first issue has been subject of Congressional hearings, and involves a question of what constitutes "fair competition" under the "inactive GOCO" facilities contract concept, where the Government pays for a certain minimum sustaining base operations cost and allows rent-free use of existing facilities. Some commercial firms are concerned that they will face a cost disadvantage related to facilities depreciation and amortization. The second issue relates to the mixed nature of the remaining GOCO plants, following the second phase of the base realignment and closure (BRACII) process. As of 9 April 1991, the following LAP and explosives industrial facilities were designated for workloading:

Plant	Primary Type	Product Type	Primary Activity
Holston AAP	Chemical manufacture	Warhead explosives	RDX, HMX
Iowa AAP	LAP—General	Tank, howitzer ammunition	Tank ammunition, artillery ammunition, FASCAM
Lake City AAP	LAP—Dedicated	Small arms	Small caliber ammunition
Lone Star AAP	LAP—General	Mine/ICM	DPICM, FASCAM
Milan AAP	LAP—General	Tank, howitzer ammunition	Tank ammunition, DPICM
Pine Bluff Arsenal	Chemical manufacture	Smoke/illum	Artillery ammunition, rocket
Radford AAP	Chemical manufacture	Propellant	Broad, varied
Crane AAA	LAP—Dedicated	Air-delivered bombs	Navy bombs

Assuming a "one viable source" strategy for each type of unique (not "general purpose") capability, the above chart suggests that Holston, Lake City, Pine Bluff, Radford, and probably Crane, would constitute a core workloaded GOCO base. All "general purpose" LAP facilities, which includes all howitzer round loading, (also tank ammunition and mines) could then compete with one another under the monitoring of AMCCOM as a final arbiter to ensure readiness. What must be carefully worked out and resolved is the competition now among three types of plants: active GOCO (Government) versus inactive GOCO versus COCO. The resolution of this industry-government capability overlap issue will require either careful negotiation, revision of philosophy, or both.

Conclusions

With regard to the three major issues regarding the industrial base, we can conclude the following:

- Foreign dependency is clearly growing, and probably irreversible, but constitutes less of a crisis than would have been the case two decades ago. Since this will not change, the U.S. Army has to look for the best and "lowest risk to mobilization" way to manage the issue. This appears to be through broad and geographically diverse company-to-company alliances across borders at the system level, with the Army a full partner in the process.

- Industrial preparedness planning is now less detailed than it must be to be meaningful, but Army in-house resources simply are insufficient to redress the shortfall. Sharing responsibilities with industry system prime contractors could improve this process by utilizing the strengths of both parties, especially if contractors are evaluated on this planning activity, and positively and negatively incentivized to perform.

- With regard to GOCO changes, the active workloaded base is being cut almost in half. The Government should maintain, in direct workloaded status, those plants which perform government-unique work (HMX, RDX, propellants, Navy bombs, etc.). An Army commitment to industry systems contracting, on the condition that LAP work be accomplished in GOCO plants via third party contracts,

could reduce the duplicating of facilities and competition between GOCO and COCO, while enhancing readiness.

Recommendations

Based upon the above analyses and conclusions regarding mobilization readiness, we offer the U.S. Army the following recommendations:

- With regard to foreign dependency, the U.S. Army should establish world-wide materials data bases, and then monitor industry cross-border sourcing agreements, at the system level. The Army should also require U.S. industry system primes to identify foreign content and to provide supply interruption risk reduction plans.

- With regard to IPP, the U.S. Army should establish a partnership with its industry systems partners to ensure future mobilization readiness, based on mutual interests and a shared vision. Success in this regard requires satisfying four key criteria:

1. Committed industrial (COCO) partners for AMCCOM to rely on for ammunition in the future.

2. Optimal relationships among COCO, GOCO, and AMCCOM, all directed towards readiness and quality at lowest total cost to the taxpayer.

3. Appropriate level for government efforts at MOB planning and detailed management of ammunition supply, and meaningful incentives for industry to plan effectively.

4. Appropriate aggregation of similar ammunition rounds with industry systems partners to allow synergistic planning and support across related categories.

Table 4-15 summarizes our recommendations regarding the U.S. Army's mobilization readiness objectives. By building industry commitment and allowing a critical mass to form in industry to accomplish new readiness objectives, industry systems contracting can contribute much to the survival of the total industrial base for ammunition.

4.1.6 Foreign Sales

The objective of this section is to describe the contribution which industry systems contracting can make to the goal of using foreign ammunition sales to help maintain the U.S. ammunition technology, production, and mobilization base.

There may be no situation surrounding today's ammunition MOB base issue where systems contracting has more to contribute than with regard to foreign sales. Conversely, there is no situation regarding ammunition where breakout policies and practices are more detrimental to achieving desired goals than in foreign sales of ammunition. There is a wide variety of legal, historical, and practical reasons that this is true, and they will be examined in this section.

Table 4-15. MOB readiness recommendations

Category/ Issue	Description	Rationale
Type of industrial partner to assure MOB base commitment	<ul style="list-style-type: none"> • Either exclusively a defense supplier or a supplier significantly dependent on continued ammunition business • Good market positions in 1-3 continuing defense markets • Manageable debt load and good cash flow • Sufficient size to apply a critical mass of both design and manufacturing expertise to problems • Thorough knowledge of government policies and regulations • Management systems and structure which are compatible with government processes and are DCAS-approved 	The Army needs industry systems contractors, for stability and readiness, but needs them to focus on ammunition business to ensure priority and commitment
Optimal relationships among COCO, GOCO, and Government	<p>System prime contractors manage ammunition production using the 120mm tank ammunition procurement model:</p> <ul style="list-style-type: none"> • Directed use of a U.S. COCO, preferably one functioning under facilities-type contract to avoid government liability and expense • Procurement from industry at the "round" level called out in budget request and appropriation. GOCO LAP plants would plant procure all materials for simpler rounds, and subcontract to primes for more complex rounds. • Breakout GFM only of common generic items where the Government clearly has a price/quantity advantage (explosives, etc.) 	<ul style="list-style-type: none"> • Utilize current GOCO base, but allow most efficient to be rewarded • Accountability for performance, and vision of the total needs • Total cost optimization
Appropriate level of detail for government IPP	<ul style="list-style-type: none"> • Government to focus on end-item round, international agreements for "fill" and supplemental quantities • Government to redouble efforts at materials and basic facilities levels (steel, machine tools, etc.) • Industry to plan round-specific readiness details, using: <ul style="list-style-type: none"> – Computerized data "knowledge" bases – International broad company-to-company agreements to reduce foreign dependence risks • Government to institute IR-managed "award fee" on fixed-price supply/system contracts, dedicated to IPP and readiness performance 	<ul style="list-style-type: none"> • Limited government workforce; top priority work must be done first • Most critical part of base to reassemble • Accountability and readiness • Incentive to follow through, rather than conduct IPP as an afterthought
Appropriate aggregation of similar ammunition rounds for maximized synergy and efficiency of IPP	<ul style="list-style-type: none"> • Examples of categories: <ul style="list-style-type: none"> – Primary fuzes (not including submunitions and integral fuzing) – Medium caliber ammunition – Tank ammunition (120mm, 105mm) – Howitzer (conventional) ammunition (155mm, 105mm) – Small caliber ammunition – Mortar (60, 81, 120, 4.2) – Rocket (small) (2.75, 5") – Air-delivered ordnance – Artillery rocket—MLRS, special category single system – Smart howitzer ammunition—(SADARM) • Each category would have 1 industry system manager, and include 1-2 GOCO plants as teammates 	<ul style="list-style-type: none"> • Arbitrary, but logically grouped categories; selected so that there is a very high probability of at least one "hot" production item in the group to serve as the base contract vehicle • A single system contractor would assume responsibility for all items in his category. • Preservation/utilization of GOCO base. Industry LAP facilities in use or laid-away (dedicated to programs) would be maintained as required

Background

Security Assistance Evolution. Historically, the U.S. has been cool to the idea of exporting armament. When the only choices were U.S. weapons and ammunition or Soviet weapons and ammunition, the foreign government buyer typically made his choice based on standard NATO/Warsaw Pact allegiance. "Security assistance" was the broad term used to describe the government's approach to our allies' defenses. The Army defines security assistance in this context as an effort to "improve the willingness and ability of allied and friendly nations' ground defense forces to reduce the risk of operational involvement by U.S. forces."¹ It included a combination of arms sales, U.S. funding (i.e. outright arms donations, training, and maintenance support), and in some cases, military advisers. Due to a combination of budget and force structure reductions described in Section 4.1.1, the U.S. Army policy has evolved into a two-pronged objective:

- Help allies defend themselves so that the limited U.S. forces are not required
- Sell weapons to maintain the mobilization base when U.S. budgets are insufficient.

When U.S. weapons were the only real choice for non-communist nations, Congress imposed stringent rules on overseas arms sales which involved taking no risk, offering no "deals," using the leverage of military export as an instrument of foreign policy, and insisting on final approval of all prospective sales above the threshold (now \$14 million). All sales were: cost reimbursable (all cost risk on buyer), 100% advance funded, limited in terms of technology, with no guarantee of delivery, and with no provisions for cost adders for R&D recoupment. Additionally, the U.S. Government had the right to cancel at any time without explanation.

As worldwide competition for arms export markets increased, the U.S. found its competitive position degraded, with its dependence on foreign sales growing rapidly. Figure 4-13 shows that even the Rock Island Arsenal receives 35 percent of its orders from overseas, with more than half of that being direct sales.

To meet the Army's security assistance and base preservation goals requires a renewed and redoubled effort to significantly increase overseas orders for U.S. weapons and ammunition. Without significant foreign sales of U.S. ammunition over the next few years, the U.S. base will face a downsizing of drastic proportions.

The Foreign Sales Challenge. Foreign sales will be more challenging in the future for several reasons.

First, all military budgets are declining, worldwide. As Figure 4-14 shows, the U.S. budget, even at reduced levels, still constitutes the largest share of the world market, so there is a relatively small additional opportunity, when considered on a marginal basis.

Second, there is a worldwide excess of military production capacity. Most governments actively try to sell their military products because they have depended for years on export sales. European aerospace and munition firms average 61 percent export sales; France alone exports 75 percent of its military production.

¹ "Army International Activities Plan," Strategic Imperatives section *Army Focus*, p. 12, November 1989

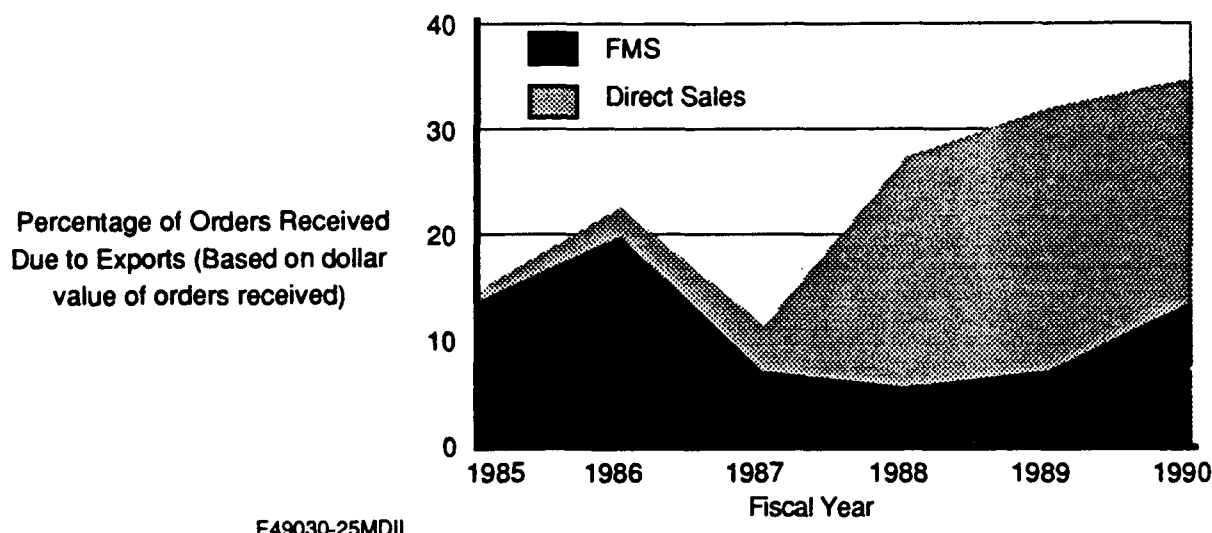


Figure 4-13. Percentage of orders received due to exports at Rock Island Arsenal (Source: Presentation by Donovan, P., Principal Deputy, USASAC, on "Marketing Defense Products and Services Abroad," Frost and Sullivan Conference, Mayflower Hotel, Washington D.C., 7 November 1990)

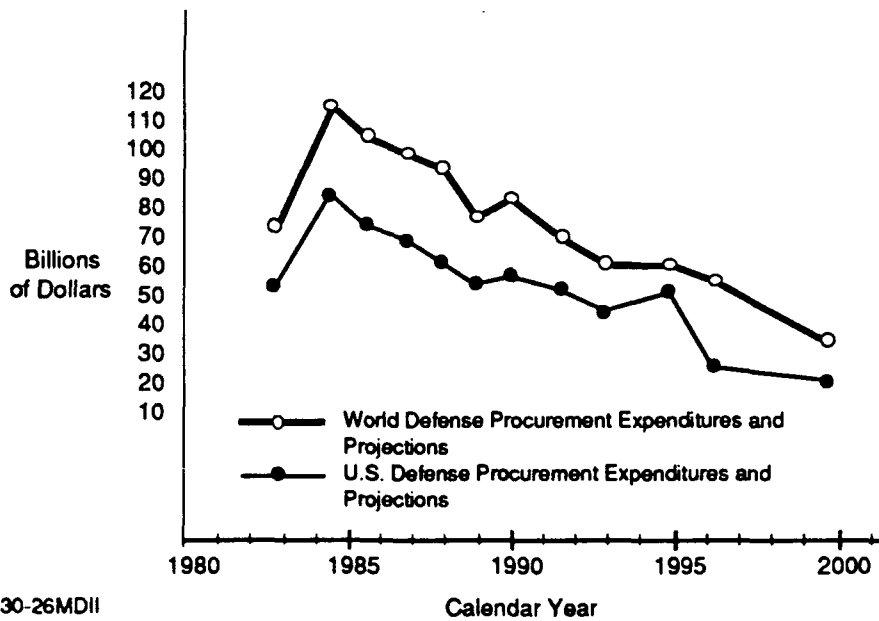


Figure 4-14. U.S. and world-wide military markets (Source: Duelfer, Charles A., Director for Defense Trade, U.S. State Department, November 90)

Third, because of budget cuts in the rest of the world, foreign firms are not only fighting to retain their own domestic orders, they are also targeting the U.S. market for their own survival. Hence, the U.S. cannot expect that a traditional passive FMS "order taking" approach will be sufficient to achieve the foreign sales needed to accomplish U.S. objectives. The U.S. foreign sales market share declined by more than 10 percent between 1985 and 1988. The formation of the "Europe 1992" alliance will lead to a group of 12 aerospace "super companies" cooperating across their borders, aggressively marketing worldwide and in many cases being subsidized by their governments.

FMS munitions marketing has not been a high priority for the U.S. Government or the Army. This is true for the following reasons: First, Public Law 97-113 explicitly prohibits U.S. diplomatic military personnel from promoting U.S.-made military equipment without high-level "exception" approval. The 20 U.S. Security Assistance Offices (SAO) around the world, plus the other 32 embassies which have assigned defense attaches, are not staffed to market munitions for AMCCOM.

Second, U.S. trade policy concentrates government efforts on products which offer substantial relative export potential (such as major weapon systems platforms). Munitions and missiles together comprise less than 6 percent of the \$6 billion in annual U.S. military exports. The relative payoff is simply not large enough to concern any government organization except for AMCCOM and its contractors.

Trends and Analyses

To sell ammunition overseas, what is required is disciplined systems marketing. Due to law, tradition, and economic issues, this is most effectively accomplished by industry systems contractors. To market either FMS or direct commercial sales, the Army needs industry systems contractors who will fully support the AMCCOM production and GOCO base. Systems contracting is required for three key reasons:

- **Product to sell.** A breakout component is not marketable to any customer except an Army buyer in the United States. Foreign governments want to buy an all-up-round which is "ready to fire."
- **Cost recovery and incentive for marketing.** Foreign marketing of ammunition is a costly and intensive process, in competition with experienced competitors. Presently, Army policies actively discourage industry marketing.
- **Offsets.** Offsets are practices whereby foreign governments require the offshore seller of military hardware to spend a portion of the cost of the job within the buying country. The U.S. Government is not presently permitted to offer offsets, as is discussed further below.

When the U.S. Army has cooperated with systems contractors to promote foreign sales, it has been effective. This was the case when it was decided to aggressively pursue foreign orders for the M1A2 main battle tank to supplement U.S. production. The industrial partners, including General Dynamics and Alliant Techsystems, performed critical legwork, aided and abetted by the Army. The Army leaders directed the high-level government-to-government campaign with our Mideast allies. The result was major commitments by Saudi Arabia, Egypt, and other smaller countries (see Table 4-16). There were several ammunition demonstration firings in both the Middle East and the U.S. (at TERA, the industry-managed New Mexico test range), where the ammunition effectiveness may have been the swing factor in securing the order over German, British, and French alternatives. This would have been very difficult for the

Table 4-16. 120mm ammunition international sales

Country	Will They Buy U.S. M1A1/M1A2 Tank ¹	If So, Will Ammo Be FMS or Commercial Sales ²	Are Offsets Required?	Remarks
Egypt	Yes	FMS	No	Coproduction required in out-years
Saudi Arabia	Yes	FMS	No, but some form of industrial participation may be required	
UAE	Yes	TBD	Yes	Subject to Congressional Approval
Kuwait	Probably	TBD	TBD	
United Kingdom	Probably Not	Commercial	Yes	Tank Decision in 1991; will probably buy UK Tank.
Sweden	TBD	TBD	TBD	
Canada	TBD	TBD	Probably	

Notes:

1. U.S. Government can sell 120mm ammunition only for M1 series tank, under terms of Rheinmetall license with U.S. Government.
2. If foreign countries buy the U.S. tank, they are virtually certain to buy U.S. ammunition.

government alone to accomplish in the time frame available. A component contractor would not have been able to arrange a demonstration firing. For non-project managed items, such as howitzer ammunition, it would have been virtually impossible for the Government to do this.

Howitzer, mortar, rocket, and other ammunition are marketed independent of the weapon platform. There are multiple worldwide sources for NATO/SEATO common weapons such as 155mm ammunition, 2.75" rockets, and the 60/81/120mm/4.2" mortars. The ammunition is RSI qualified as interoperable, so there is no inherent reason to buy from the U.S. In all cases, full rounds can be supplied by foreign competitors (e.g., Rheinmetall or MECAR for 155mm ammunition), whether to their own governments, or for export. When U.S. companies only supply a small piece of the round, they cannot compete against such foreign firms. The Army has recently upgraded its emphasis on foreign sales of ammunition, and AMC has begun to dedicate some personnel resources to the challenge. This new attention will best payoff if the effort is combined with those of industry systems contractors, because the U.S. Government is still restricted from many of the actions which are needed to succeed. Table 4-17 summarizes those requirements necessary to compete in the foreign sales arena.

AMCCOM's cost allowability policies discourage industry FMS marketing. For example, a U.S. firm may have a 10 percent General & Administrative (G&A) overhead rate for domestic production, and a 15 percent G&A rate for foreign sales, due to the costs of international marketing (includes people, travel,

Table 4-17. Requirements to accomplish successful foreign sales

Need	Capability of Industry System Prime	Capability of Government
• "Native" (country) trading company or agent who knows people and processes	Yes — Company-to-company agreements	Not allowed
• Flexibility to pay reasonable sales consultant compensation out of profit	Yes — Provided it's not in rate structure or contrary to law	Not allowed
• Freedom to conduct relevant operational analyses (for the local geography) to sell the munition as a key component of allied country's weapons mix	Yes — Routine sales tool	May be limited by TRAC workload and service doctrine
• Ability to provide real-time technical information as permitted under ITARS	Yes — Prime contractor has export license and knowledge	Yes
• Freedom to deal with all levels and elements of foreign government	Yes — No intragovernment protocol	Limited by diplomatic protocol
• Freedom to enlist Embassy and Commerce department support for marketing efforts	Yes — Secretary Eagleburger message of Aug. 1990	Yes
• Ability to contract with foreign governments on a fixed-price basis	Yes	Policy currently conflicts with FMS procedures
• Ability to proactively sell the product	Yes — Routine process	No — Unless approved by the executive branch as an exception
• Ability to safeguard classified information transmitted IAW NDP.	Yes — Technical Assistance Agreements (TAA)	Yes — Country-to-country MOU.
• Ability to respond with immediate travel when required	Yes — Freedom to travel is routine	Yes — Approvals required, travel orders processed
• Ability to deal with required offsets in a way which protects U.S. interests	Yes — Standard requirement	No — U.S. currently rejects recognition of offset

administration, demonstrations, currency fluctuations, etc.) and of exceeding IR&D/B&P allowability ceilings. Under current practice, AMCCOM PCOs do not accept industry FMS G&A rates, even if contractors have assisted with marketing the FMS sale. This actively discourages industry marketing of AMCCOM rounds.

Substantial proactive effort is required to counteract foreign firms whose country's laws don't prevent contingent fees, gratuities and offsets. As shown in Table 4-18, offsets are widespread and often even required when conducting foreign business, yet they cannot be implemented directly by the Government. When offsets and co-production (i.e., "industrial participation") are required, the U.S. ammunition primes, in cooperation with AMCCOM, can work to protect key U.S. mobilization capability. Offsets are not always direct, in-country production of hardware, with the impact this can have on a production MOB base. A firm may have an "excess" offset credit on another, non-critical, non-mobilization item which could be applied to keep a key munitions product produced in the U.S. plant. In a worst-case situation, industry can even purchase "offset credits" through an offset broker. When a customer insists on offset as a matter of national policy, only an industry system prime can respond.

Table 4-18. Offset policies of key historic customers for FMS and direct sales of munitions

Country	Statutory or Customary	Offset	Offset % Required
Australia	Statute	Yes	60-100%
Belgium	Statute	Yes	40-60%
Canada	Statute	No	100%
Germany	Custom	Yes	0-60%
Greece	Statute	Yes	60-100%
Korea	Statute	Yes	30-100%
Saudi Arabia	Statute - Various	Yes	40%
Spain	Statute	No	100%
Switzerland	Statute	Yes	30-100%
Turkey	Statute	Yes	40-80%
UAE	Statute	No	60%
UK	Statute	Yes	30-100%

155mm Foreign Sales Example. A brief market analysis of howitzer ammunition foreign sales follows:

- 155mm U.S.-compatible gun tubes deployed (from Jane's, Forecast International):
 - Core, NATO, SEATO: Approximately 2400
 - Second tier: Approximately 1200
- Average worldwide demand for 155mm ammunition, 1990-1999, as estimated by Forecast International: 3.5 million rounds/year
- In-country 155mm production capabilities exist in Argentina, Austria, Belgium, Canada, Brazil, France, Germany, Greece, Israel, Italy, ROK (Korea), Netherlands, Pakistan, Singapore, South Africa, Spain, Sweden, USA.

Table 4-19 shows that the market is flooded with the simpler, lower cost 155mm rounds, but the U.S. has a market "niche" open for submunition and "smart" rounds which could be exploited. The simpler ammunition rounds are less valuable to export in terms of gross dollars. They also have shorter lead times, and are simpler to start and stop production.

The U.S. dominates in higher value, more complex, and more marketable rounds such as DPICM, Howitzer-delivered Mines (ADAM, RAAM), Copperhead, SADARM (eventually), and extended capability rounds of the future. Potential customers identified for these items possess 2,600-3,000 155mm gun tubes.

One major reason for the DPICM, ADAM, and RAAM preference in the overseas marketplace is that those systems have been marketed by industry firms acting as system primes, using investment dollars. Copperhead has seen little demand, due to the planned follow-ons, but this may change as a result of the Gulf War and the demise of APGM. The AMCCOM base and load plants have opportunity to derive significant benefit from such sales, including Louisiana AAP, Iowa AAP, and Lone Star AAP.

Table 4-19. World-wide artillery suppliers (gun-fired) (Source: Jane's, Forecast International)

(Facilitized — Not all in Production)											
All Rounds and Suppliers Warranted to be M109 Compatible											
	155mm M107 HE (Equiv)	WP	Be Smoke	Illum. Rounds	ERFB*	Base Bleed (BB)	Rocket Assisted Projectile (RAP)	DPICM	AP Mines	AT Mines	Smart
Non- U.S.	22	10	10	12	7	6	5	4	0	2**	2**
U.S.	3****	1	1	1	0	2	1	3	1	1	3***
(Nuclear Rounds Not Included) * Extended Range, Full Bore. The U.S. has no equivalent ** French and Israeli rounds advertised, production status uncertain *** Copperhead — In layaway, but producible SADARM — In development, German equivalent **** LAAP, MAAP, SAAP — Not necessarily in production											

Other rounds could be marketed aggressively also, if the opportunity were worthwhile and if AMCCOM encouraged development of a system supply capability in industry. AMCCOM benefits most from a direct sale. The GOCO can charge "what the market will bear," increasing the sales base and reducing U.S. burden rates by increasing GOCO sales base. Even for breakout items, AMCCOM can charge foreign customers for all OMA-funded support, to avoid U.S. subsidy and waste/fraud/abuse issues.

Export Barriers. FMS and commercial sales overseas could be increased if unnecessary export barriers were eliminated. Table 4-20 summarizes existing barriers to effective implementation of the Army's export strategy to preserve the mobilization base. All of the solutions postulated in the table are legally implementable, with only institutional custom preventing implementation.

Cooperative R&D. In the mid '80s, international cooperative R&D seemed to be a viable way to meet U.S. development funding shortages. This took two forms: 1) NDI acquisitions of foreign weapons; 2) Multi-country joint R&D programs under the Nunn-Quayle Amendment. Note that foreign countries do not fund contract R&D by American companies unless they receive more existing American technology through the contract than they would obtain by merely funding their own companies and labs.

U.S. technology imports tend to be NDI items. The government's willingness to buy tends to follow either urgent need (120mm ammo) or effective marketing by a U.S. partner (AT4 and MSE). These programs share a common trait: they didn't involve seminal research, but instead applied existing technology. In each case, their success was heavily dependent on close company-to-company cooperation between two systems contractors (Rheinmetall-Alliant Techsystems, GTE-Thomson CSF, FFV-Alliant Techsystems), permitted and facilitated by their governments as non-interfering partners. The future NDI trend is heavily tied to "immediate need." NDI procurement diverts work from the U.S. tech base, but

Table 4-20. Barriers to ammunition exports

Problem/Barrier to Export	Reason	Solution
Lack of industry incentive to market; high cost of international marketing	Breakout procurement; unallowability of costs	Systems contracting, direct sales, realistic breakout prices via UCR
Technology repeatability barriers (for unclassified hardware sales)	Perception of technology uniqueness	Realistic assessment of world-wide technology. Clear communication within AMCCOM of "pro export" policy.
Perception of threat to U.S. stockpiles (viability of real-world countermeasures)	Fear that U.S. sensor systems can be rendered useless by countermeasures	Realistic analysis of the role of sensors and smart systems in dynamic combat environment. Recognition of foreign availability of sensor technology.
Sale of U.S. TDP to foreign countries (resulting in easier startup of foreign factories)	Unknown—national policy to respond to allies	Direct hardware sales, with TDP costs absorbed into costs. Co-production on more limited basis.
Lack of U.S. system contracting experience and incentive to market	Breakout procurement	Evolution of U.S. systems contracts for production, to make foreign sales possible and to facilitate them

saves R&D money. The current trend has been up, but will decline significantly as U.S. procurement dollars fall.

Cooperative R&D has declined in recent years, because of the demise of many programs such as the 155mm APGM (Copperhead replacement), which was cancelled by Congress due to budget demands. Future technology/R&D growth through international cooperation will realistically occur only through company-to-company cooperation, whether teamed for U.S. or foreign system R&D contracts, or for independent development (investment). This cooperative R&D can only occur if the company sales base is large enough to support a critical mass level of IR&D. The key to cooperative R&D ventures is industry systems contracting, with sensible allowability of IR&D and B&P expense.

Conclusions

Foreign sales of ammunition are vital to the U.S. Army. They can help maintain the industry mobilization base, retain GOCO capabilities, reduce U.S. production costs, and keep facilities in operating condition. On a strategic level, U.S. influence and national security are enhanced when other nations rely on our continued logistic support, maintenance support, supply of spare parts, and technical support for

their armed forces. While the U.S. budget contains continued support for ammunition, the last U.S. howitzer submunition production shuts down in 1992 when the M731 and M864 buyouts are complete. Under circumstances such as these, foreign sales of howitzer ammunition becomes especially important because of its potential contribution to the U.S. mobilization base capability.

Foreign sales objectives can best be met by industry systems contractors, working in partnership with the Army, for an overwhelming reason: The competitive challenge requires a level playing field of systems supply capability and aggressive export marketing. If the U.S. Army allows American industry to compete this way, and reduces unnecessary barriers to export, industry system primes can increase foreign sales of their ammunition and enhance the U.S. Army's mobilization base accordingly.

Recommendations

Based upon the preceding analyses and conclusions, we offer the U.S. Army the following recommendations:

- The U.S. Army and the Government should procure FMS ammunition rounds on an industry systems contracting basis, at the same level as they are requested in the Letter Of Agreement (LOA). If an industrial firm has expended significant cost and effort to secure an FMS order on behalf of the Government, the U.S. Army should support industry's role as systems management focal point with the foreign customer.
- The U.S. Army and the Government should revise the breakout pricing model currently used to price FMS estimates to include all costs, as defined in the Unit Cost Resourcing (UCR) guide issued by the OSD comptroller.
- The U.S. Army and the Government should revise FMS cost allowability practices immediately to accept FMS G&A rates in all FMS negotiations.

4.2 Cost

This section consists of two cost-related discussions (Total Cost and Investment) and one schedule performance/management discussion (Schedule). While the investment analysis could have been included in the Readiness section, we felt that the cost implications of contractor investment justified its inclusion in this section. The schedule analysis has been included here for analogous reasons.

4.2.1 Total Cost

The objective of this section is to document the potential cost benefits that industry systems management techniques may offer to the Government.

Our analysis focused on total cost—the cost to the Government of acquiring a system from concept definition, through full scale development, to production. Hidden costs (i.e., those cost/accounting differences between government and industry, resulting in UPC starting points) were included in the analysis. Operational and demilitarization costs were not included in the analysis.

To quantify our analysis of total cost, we focused heavily on learning curve differentials between industry system-managed programs and government system-managed programs (i.e., breakout procurements). Learning curves may be defined in this context as a mathematical expression of the phenomena where every time the unit number doubles in production, the cost of the device drops by the learning curve percentage factor.

Using AMCCOM-generated data and Alliant Techsystems data, we compared unit price experience curves from the 120mm tank ammunition program (an industry system-managed program) with those from other ammunition programs which featured breakout procurements. This analysis projected significant cost savings to the Government and AMCCOM of using an industry system management approach to howitzer ammunition procurement.

The remainder of this section presents Total Cost background, a trends and analyses discussion, and a set of conclusions and recommendations based upon our analyses.

Background

As discussed in Section 4.1.2, it has historically been DoD and AMCCOM policy to encourage component breakout whenever apparent cost savings can be achieved and the decision will not jeopardize delivery of the end item. DoD guidance states that each decision on whether or not to breakout a component must include a calculation of estimated net cost savings. Estimates of probable cost savings should be developed for each case on its own merits, with consideration given to any estimated offsetting costs. These offsetting costs can include increases in the cost of requirements determination, contract administration, data package purchase, material inspection, qualification or preproduction testing, ground support and test equipment, transportation, security, storage, distribution and technical support.

A review of component breakout data prepared by AMCCOM demonstrates a generalized methodology for evaluating component breakout that normally includes the following contractor expenses:

- Hardware component costs
- Direct labor
- Material overhead
- G&A
- Profit
- Contractor price.

The additional government management costs associated with component breakout are recognized. However, because of the difficulty in computing these management costs, they tend to be narratively discussed, but not quantified.

It can also be seen, from the above, that the common perception which prevails throughout DoD is that government systems management saves the Government the cost of the contractor's top rates for overhead, G&A, and profit, and that these cost savings alone satisfy the 10% required savings to justify breakout.

The issues to be addressed in the study, therefore, are:

1. What is a realistic comparison of the government's and industry's top rates.
2. Which procurement method provides the lowest cost.

Product Acquisition Costs: Industry vs. Government Rates. There is a different accounting structure used for industry systems-managed programs than for government systems-managed programs. Industry is required to place an equitable share of the operating expenses against the cost of the product being sold. Costs that are not clearly identifiable to a specific product are allocated to specific products based on other costs which are clearly identifiable to specific products. This is done in order to determine the true cost of goods sold and to set reasonable prices and profits for each product.

Government acquisition of military material is often driven by the goal of minimizing cost within a fixed cost environment (i.e., GOCO's, GOGO's, bases, etc.). Allocating fixed costs to procured ammunition is not required by the Government on its own system-managed programs due to the lack of any recognized need to link those fixed costs to a specific product. Thus, while industry allocates all of its costs to specific products, Government does not. Industry allocates fixed costs by adding rates to items or categories that can be clearly identifiable to a specific product. With Government system management there is, of course, no profit associated with that element of the total cost. (See following discussion in the Trends and Analyses subsection.)

Product Cost Improvement. The basic assumption of Product Cost Improvement Curve Analysis (i.e., learning curve analysis) is that different acquisition strategies and processes influence the shape of the price improvement curve. The basic acquisition strategies studied in this analysis are:

- Sole Source Industry Systems Management
- Competitive Industry Systems Management
- Government Systems Management with Commercial Subcontractors (i.e., Breakout).

Regardless of the acquisition scenario, the business objective of the industrial contractor is to make a fair and equitable profit. Each acquisition scenario allows for different cost reduction strategies to obtain the profit goal. The strategies for each acquisition scenario are as follows:

• **Sole Source Industry Systems Management.** In a single source environment, the Government negotiates material, labor, overhead, and overhead rates to achieve a fair price. The motivational factors for industry to reduce cost, at the government's disposal, are breakout or competition. Two distinct strategies that industry uses for cost reduction are: 1) Minimize cost reduction to get the largest cost-based profit through skillful contract negotiation with the Government, or 2) Maximize cost reduction using a strong VECP/cost reduction culture to earn the right to keep programs single source, and offset the loss of cost-based profit with VECP-based profit and additional units sold to the Government or to foreign customers through FMS.

• **Competitive Industry Systems Management.** In a competitive/multiple source environment, cost reductions by industry are achieved by voluntarily reducing material, labor, support, and overhead to allow the lowest profitable bid to be submitted to capture the majority of the business (i.e., acquisition dollars). Aggressive cost reduction activity occurs at both the system and component level.

• **Government Systems Management.** This is a noncompetitive environment at the systems level, where cost reduction occurs due to competitive sourcing of materials, piece parts and assemblies. As a single source, the government procuring agency does not have to negotiate or compete at the system level. Thus, aggressive cost competition occurs only at the component level.

Trends and Analyses

This subsection will present data on production acquisition cost differences in applied "top rates" and cost improvement (i.e., learning curves). The "top rates" form a UPC starting point differential when comparing cost improvement between various programs. Data used in this section are from subassemblies (i.e., ADAM) and final assemblies (i.e., 120mm) since it is assumed that common trends exist in both types of programs, such as magnitude of program revenue, product complexity, and assembly responsibility.

Product Acquisition Costs: UPC Starting Point Differential. There are several cost pools plus profit that add cost to a product. Some typical cost pools are shown below with representative rates drawn from various munitions industry sources:

Cost Pool	Reasonable Value
Material Acquisition (Material Only)	3.5%
Selling and Technical (S&T)	12.0%
General and Administrative (G&A)	3.0%
Profit	<u>12.0%</u>
Total Rate	30% (approx.)

Labor Fringe/Burden Rates. Before performing any analysis of the cost pools of Material Acquisition, S&T, G&A and Profit, a labor cost basis must be established. In the labor burden and fringe accounts are included a variety of costs ranging from electricity, telephone, office supplies, information services, building occupancy, etc. These costs are examined below so that we can properly allocate costs to government versus industry systems managed programs.

Industry Labor Fringe/Burden Rates. Table 4-21 presents a representative labor burden breakdown for a typical munition systems contractor. A representative burdened labor and fringe rate, based on a \$45,000 per year salary, a 40% labor fringe rate, and a 130% labor burden rate, is \$145,000.

Government Labor Fringe/Burden Rates. From data received from AMCCOM, we have constructed the following rate analysis. To begin, the representative average salary for ADAM and RAAM procurement and support personnel in the Government is \$42,450. Multiplying this number by the fringe rate of 39% (without unfunded retirement benefits) results in a labor and fringe rate of \$59,000. The burdened labor and fringe rate for the Government is \$100,000, which implies a burden rate of 60 to

Table 4-21. Breakdown of labor burden rates for typical munition systems contractor

Burden Category	Element	Category Rate (Estimated)	Distribution by Element	Distribution by Total	Government Handling of Element
Indirect Labor	Group Leader		34%	6%	
	General/Non-Specific		15%	3%	
	Training		8%	2%	
	Burden Projects		8%	2%	
	Paid Absence		7%	1%	
	Overtime/Shift Bonus		7%	1%	
	Other		20%	3%	
	Total	22.9%	100%	18%	
Salaries (Non-Time Reporting)	Total	10.6%	100%	8%	
Supplies and Expenses	Depreciation		38%	8%	O&M Pool
	Telephone		8%	2%	
	Travel		8%	2%	
	Office Supp/Oper Exp		13%	3%	
	Other		34%	7%	
	Total	28.1%	100%	22%	
Services	Information Services		53%	11%	
	Tool Support/Repair		10%	2%	
	Burden Tooling		5%	1%	
	Maint/Stores Transfer		9%	2%	
	Other		23%	4%	
	Total	26.1%	100%	20%	
Allocation to Cost Centers	Building Occupancy		55%	17%	O&M Pool
	Personnel & Security		18%	6%	
	Management		9%	3%	
	Other		18%	6%	
	Total	39.4%	100%	31%	
Miscellaneous	Total	2.9%	100%	2%	
Total		130.0%		100%	

70 percent. This is close to industry's rate, if items that are covered by the O&M pool (i.e., Supplies and Expenses, and Allocation Cost Centers) are subtracted out. Therefore, assuming industry's rates for items covered by O&M funds, the equivalent government burdened labor and fringe rate should be around 130%. This results in a fully loaded labor and burden rate of \$135,700, when a proportion of O&M funds are factored in.

Material Acquisition Rates. The material acquisition rate is the total cost of bringing procured material in from subtier suppliers for the purpose of manufacture or assembly into the next higher device

(final assembly or subassembly). The rate is merely the total cost to perform the acquisition function (for a given fiscal year) divided by the estimated material base to be procured in that year.

Industry Material Acquisition Rate. A typical material acquisition rate for industry is 3.5%. A breakdown of typical material acquisition elements for industry is shown in Table 4-22.

Government Material Acquisition Rate. To develop a material acquisition rate for the Government, we once again drew upon data provided by AMCCOM on the ADAM and RAAM programs. The cost of government procurement personnel for ADAM and RAAM is equivalent to the number of personnel (6.64) multiplied by \$100,000 per head (labor, fringe, and O&M allocation for 6.64 people) and divided by the material value of the rounds bought per year. The number of ADAM rounds was estimated at 1,700 per month with a material and LAP value of \$5,100 each. The number of RAAM rounds was estimated at 4,000 per month, with a value of \$1,600 per each. The resulting salary and O&M costs divided by the value of the rounds is 0.37%. Using the same cost elements as industry and the proportions listed, the material acquisition rate for the Government would be 2.3% versus 3.5% (for industry).

Top Rates. Top rates refer to a general class of expenses and profit required to run the selling organization. Since the Government does not generally "sell" material, it is not required to determine such a rate. However, for industry systems management, a rate has to be applied.

Industry Top Rates. Table 4-23 shows a typical breakdown of industry top rate elements and qualifies how the Government handles that cost element. It has been asserted in several breakout analyses that industry's typical 30% top rate is without equivalence in the government cost sector. As the following analysis will show, the effective top rate for industry is not 30%, but instead much lower. Without much question, the Marketing and B&P expenses which comprise 55% of the S&T rate is a cost without equivalence in the Government. The contracts organization cost in the S&T rate, however, has its

Table 4-22. Breakdown of material acquisition elements for typical munition systems contractor

Rate Category	Elements	Category Rate (Estimated)	Breakdown by Element	Government Handling of Element
Material Acquisition	Procurement Salaries	1.6	45%	1.
	Supplies/Expenses	.3	9%	2.
	Finance	.1	4%	2.
	Information Services	.2	6%	2.
	Allocation	.4	10%	2.
	Management Allocation	.7	19%	2.
	Freight-In/Dock to Stock	.2	7%	2.
	Other			
	Total	3.5%	100%	

1. Directly charged to program. Not part of a top rate.
2. A real cost, but not charged to a specific program.

Table 4-23. Breakdown of industry top rate elements

Rate Category	Elements	Category Rate (Estimated)	Breakdown by Element
Selling and Technical (S&T)	Selling	3.7%	31%
	Marketing	1.2%	10%
	Contracts		
	Technical	3.7%	31%
	IR&D	2.9%	24%
	B&P	.5%	4%
	Other		
	Total	12.0%	100%
General and Administrative (G&A)	Corporate Staff	2.4%	80%
	Bid Rates/Cost Control	.2%	8%
	Other	.4%	12%
	Total	3.0%	100%
Gross Profit	Taxes	5.4%	45%*
	ROI (40/60 RE to D)	4.2%	35%
	Retained Earnings (RE)		
	Dividends (D)	2.4%	20%
	Interest Payments		
	Total	12.0%	100%

* See Taxes description below

equivalence in the Government and is the cost of being a government contractor. Moreover, the IR&D costs are of direct benefit to the Government since IR&D provides the seed money for future products.

The 12% profit top rate does not appear to have an equivalent in Government. However, upon further examination, the majority of profit returns to the Government in taxes or in benefits to the Government in the form of investment. A further breakdown of profit dollars is shown below:

- **Taxes.** Approximately 45% of gross profit returns back to the federal and state governments as various taxes (after expenses, carry-backs and carry-forwards). This 45% is equal to 5.4% of the total top rate. 45% used to cover all possible federal and state combinations in the U.S. Use of 45% lowers estimated government top rate in Table 4-24.

- **Retained Earnings.** Though retained earnings do not return back directly to the Government, the Government still benefits from retained earnings since they enable an industry contractor to remain financially stable and thereby help sustain the ammunition mobilization base. Retained earnings also lowers the cost of debt when additional outside financing is required by an industry contractor.

- **Dividends.** If the company pay dividends to its stockholders, they are taxed as income by the stock holder. Assuming a 28% tax rate, this is equal to .7% of the total top rate.

The net result is that the 12% profit rate net of taxes is really equivalent to 6%, resulting in industry's top rate actually being 24% instead of 30%.

Government Top Rates. If the Government allocated costs like industry, a portion of the cost of the President of the United States and Congress (i.e. corporate expenses) would be allocated to the buying activities of the DoD. However, such an allocation does not currently factor into making an

government or industry systems contracting decision. An estimate of government "Top Rates" can be made where common cost elements, such as research and development, price and cost analysts, etc., exist in both types of acquisition environments. From the cost pools common to Government and industry, we have constructed a government top rate breakdown (see Table 4-24). This breakdown shows the equivalent government top rate to be 22.3% (versus the assumed 30% or adjusted 24% top rate of industry).

Product Cost Improvement. The elements of learning can be defined as follows²:

- Personnel Learning — Learning of procedures by workers

Table 4-24. Breakdown of equivalent government top rate elements

Rate Category	Elements	Category Rate (Estimated)	Breakdown by Element	Government Handling of Element
Selling and Technical (S&T)	Selling	3.7	31%	N/A
	Marketing	1.2	10%	1. 2.3%
	Contracts			
	Technical	3.7	31%	2. 7.1%
	IR&D	2.9	24%	N/A
	B&P	.5	4%	3. 0.5%
	Other			
	Total	12.0%	100%	9.9%
General and Administrative (G&A)	Corporate Staff	2.4	80%	4.
	Bid Rates/Cost Control	.2	8%	4.
	Other	.4	12%	4.
	Total	3.0%	100%	3.0%
Profit	Taxes	0.0		N/A
	ROI (40/60 RE to D)	3.6	60%	N/A
	Retained Earnings(RE)			
	Dividends (D)			
	Interest Payments	2.4	40%	5. 3.8%
	Total	6.0%	100%	3.8%
	Compounded Rate	22.3%		17.5%

Notes:

1. The Contracts rate of 2.3% is from the FY91 budget submittal.
2. The IR&D rate is the budgetary proportion of the RDT&E rate for technology base in the FY91 budget divided by the procurement dollars budget.
3. The "Other" rate is assumed to be the same as Industry's rate.
4. The "G&A" rate is assumed to be the same as Industry's rate.
5. The interest payment is the cost to float unplanned material at the load plant at 9.5% on material that makes up 40% of the base.

²Anderlohr, George, "What Production Breaks Cost," Industrial Engineering, Vol. 1, No. 9, pp. 34-36, September 1969.

- **Supervisory Learning** — Learning by supervisors to direct operations, run factories and train occasional replacement workers
- **Continuity of Production** — Learning due to working and operating machines, continuity of material flow, and line balancing
- **Methods** — Learning due to physical plant layout, production process, and technical data package improvements for producibility and quality
- **Special Tooling** — Learning due to tooling and tool change improvements.

Industry Cost Improvement. Using an Alliant Techsystems' data base, we calculated learning curves for major munition programs at the component and total device levels. The calculations show that all cost elements of industry-produced items demonstrate cost improvement on competitive and noncompetitive programs. The following assumptions were used in the calculation of all learning curves:

- All conversions from then year dollars to constant year dollars were made, using the January 2, 1991 OSD/OMB, CPIU, WPI IND inflation guidelines
- All learning curves for various cost elements (i.e., material, support etc.) were constructed from actual costs not budgeted costs
- Two or more years of production was used in the determination of the learning curves
- All data was taken from programs without production gaps (unless so noted)
- All programs were regressed with all data points and again without the first one or two production lots to reduce or estimate the effects of production rate acceleration on the learning curve slope
- The first unit cost "A" was omitted due to the competitive nature of some of the programs and the proprietary nature of the learning curve data.

A summary of our findings are shown in Tables 4-25 through 4-27. Note that the inclusion of all lots in the calculation of the learning curve ignore production rate effects inherent in production programs. Table 4-25 presents total round learning curve data, Table 4-26 presents material learning curve data, and Table 4-27 presents LAP learning curve data.

Note that for Table 4-27, LAP for GAU-8A and Bushmaster was performed by Alliant Techsystems at JAAP, CEM by Day and Zimmerman at KAAP, 120mm by Mason and Hanger at IAAP, and Rockeye by NAD Crane.

Government Improvement Data. The government learning curve data is supplied primarily from the 1983 edition (the latest edition available) of the Ammunition Cost Research Study.³ The

³Ammunition Cost Research Study, Volume 1, p. 14, Cost Analysis Division, US Army Armament Materiel Readiness Command, Rock Island, Ill., January 1983.

Table 4-25. Learning curve data by program — total round (all lots used except where noted)

Program	Learning Curve Slope %
Bushmaster Ammunition	
TP-T (All Lots Except 1st)	67%
HEI-T (All Lots Except 1st)	70%
APDS-T (All Lots Except 1st)	64%
GAU-8/A Ammunition	
TP	83%
HEI	80%
API	82%
120mm Tank Ammunition	81%
ADAM Mine (See Note)	82%
Rockeye (without/LRIP Lot) Munition	78%
CEM Munition	79%

Note: Though ADAM is **not** currently procured as a complete round, it is included in this table for several reasons: first, ADAM was developed as a system by an industry systems manager; second, the current Alliant Techsystems production portion of the round constitutes 70% of the round's total value; third, because of an industry manager's involvement in areas such as foreign sales of all-up rounds, (i.e., Alliant Techsystems'), ADAM is more representative of a system procurement than a breakout one.

Table 4-26. Material learning curve data

Program	Learning Curve Slope %
Bushmaster Ammunition	
TP	77%
HEI	88%
API	77%*
GAU-8/A Ammunition	
TP	89%
HEI	83%
API	85%
120mm Tank Ammunition	<85%
ADAM Mine (See Note above)	84%
CEM Munition	85%
Average	85%*

* Average is 86% if Bushmaster API not in calculation. This would reflect not using <80% learning curves as in the government supplied data.

Table 4-27. LAP learning curve data

Program	Learning Curve Slope %
Bushmaster Ammunition	86%
GAU-8/A Ammunition	81%
120mm Tank Ammunition	79%
CEM Munition	83%
Average	82.3%

learning curves documented in this study are reported at the component family level. Table 4-28 shows the government's learning curve experience. The methodology used in the analysis of the government data was as follows:

- Component must have two or more years of production cost history by a particular vendor to be included (curves were generated by part and vendor)
- If a production break occurred and a reduced cost was experienced after the break, the break was ignored
- Individual learning curves greater than 100% or less than 80% were ignored in calculating the composite curve result.

Table 4-28. Government learning curve experience

Component LAP	Composite Learning Rate	Component Projectile	Composite Learning Rate
High Explosive	90.4	High Explosive	91.0%
Armor Piercing	94.6%	Armor Piercing	93.3%
Target Practice	93.5%	Target Practice	91.8%
Illuminating	92.9%	Illuminating	94.9%
Smoke	93.1%	Smoke	92.6%
Chemical	93.8%	Chemical	98.3%
Average =	93.05%	Average =	93.65%

Comparison and Analysis of Product Cost Improvement Differences. A summary of the learning curve comparisons is shown in Table 4-29. There are three main reasons to explain the differences in product cost improvements between government systems contracting and industry systems contracting:

- Aggressive pursuit of VECs by system prime contractors as a competitive weapon
- Use of bridge funding by system prime contractors to avoid production gaps and loss of learning
- Active engineering support of small to medium sized subcontractors by system prime contractors to help reduce cost.

Table 4-29. Learning curve comparisons

Program	Government Learning Curve	Industry Learning Curve
Material	94%	85%
LAP	93%	82%
Fuze	89%	83%
105mm (Breakout)	TBD - Data Not Available	NA
120mm (System)	NA	81%

Product Cost Analysis and Decision Making. Having scoped the parameters of cost improvement and starting point differentials, we can now analyze the tradeoffs between government systems management and industry systems management. This analysis will demonstrate that due to the difference in product cost improvement, the number of units required to offset the starting point differential (be it 5%, 10%, or 15%) is relatively small. This is true if the projected quantities left to be procured is two to three times the cost comparison base.

For example if the cost for 10,000 systems under breakout is \$1,000 per each system, the costs for an industry systems-managed program would be \$1,050, \$1,100 and \$1,150 per each system or the first lot of 10,000 systems. The learning curve of government systems-managed material would improve at a rate of 94%. Material procured through industry systems-managed programs would improve at a rate of 85%.

Figure 4-15 depicts the UPC improvement for a 10% learning curve cost differential scenario. Figure 4-16 depicts the savings per year and cumulative savings chart for the 10% cost differential scenario.

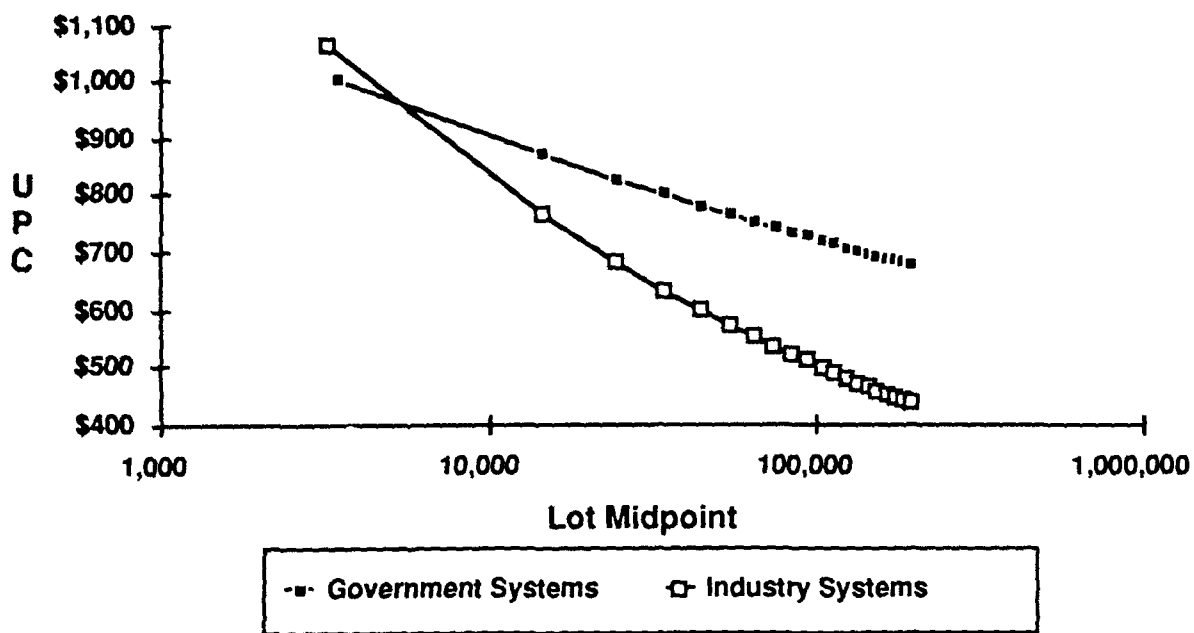
The results in terms of years to breakeven are:

Rate Differential	Years to UPC Crossover	Years to Breakeven
5%	1	2
10%	1	3
15%	1	4

As can be seen, the amount of time to achieve a lower UPC with industry systems contracting is quite short. The number of years to achieve total dollar breakeven is longer. It is estimated that with a typical rate differential between 5 and 15 percent, the Government experiences a breakeven between two and four years of production, and true total cost savings thereafter. In terms of funding profiles (i.e., UPC crossover point), the improvement occurs within one to two years.

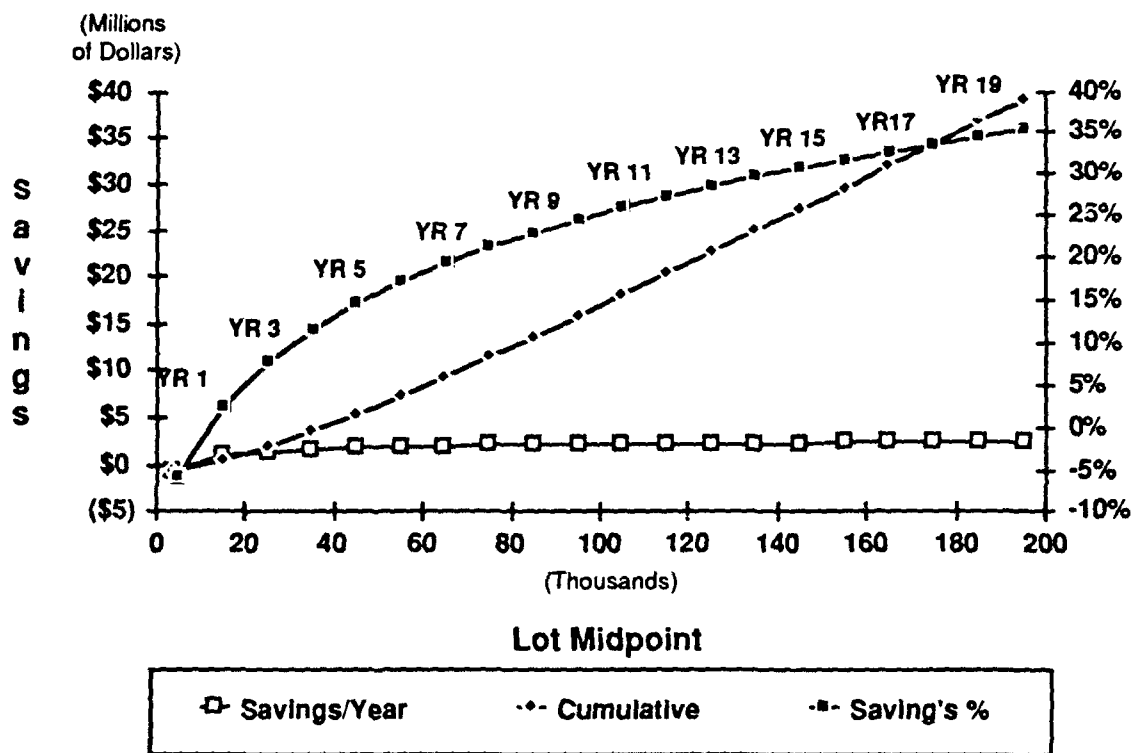
Conclusions

Drawing upon data from a broad spectrum of ammunition and munition programs, we can conclude the following:



E49030-38MDII

Figure 4-15. Learning curve model of procurement (based on typical learning curve differentials)



E49030-39MDII

Figure 4-16. Cumulative savings to the U.S. Government (based on typical learning curve differentials)

- Assemblies and systems procured from industry systems contractors have significantly steeper experience/learning curves than piece parts procured from component contractors under breakout.

- Learning curve improvement is a result of investment driven by program revenue: piece part procurements have flat learning curves and low revenues, assembly and system procurements have steeper learning curves and higher revenues.

- There are two other good reasons for the learning curve differentials of 5% to 10% between industry systems management and government systems management procurements:

1. Lack of production gaps due to bridge funding (approximately 5% of differential). Note that supporting data is drawn from ADAM and 120mm programs.

2. Strong cost reduction and VECF performance (approximately 3% of differential). Note that supporting data is drawn from ADAM, 120mm, and Rockeye programs.

- Adjusting for the government's hidden costs, top rates (G&A and S&T) for industry and government are about the same since common functions exist between industry and government

- Single-source industry systems primes can achieve improvements rates as steep as competitive awards if the industry systems prime has a strong cost reduction/VECF culture and is encouraged to do so by the Government

- Fixed priced production contracts represent lower risk to the Government in industry systems management acquisitions than in the government systems management acquisitions. The cost for this risk reduction is industry systems managers profit.

Recommendations

In terms of cost, not all programs can benefit from industry systems management. The learning curve analysis implies that the top rate offsets can only be paid for by programs of sufficient size. When such is the case, the U.S. Army should procure ammunition using industry systems contracts to allow and facilitate industry to do what industry does best:

- Value engineer the product
- Support small subcontractors with engineering expertise
- Manage production with bridge funding if necessary to avoid production gaps
- Control costs by bringing cost driver components in house to manage and control
- Fix product problems via industry's shorter command and control loop.

Pure cost competition will drive cost lines down and encourage cost-cutting behaviors by contractors that may undermine the U.S. Army's mobilization and readiness requirements for ammunition. Hence, the U.S. Army should establish a contractual framework rewarding those behaviors desired by the Government in a broad application of industry systems-managed programs. In such a framework, the U.S. Army should:

- Use competitive multiyear procurements to increase the system contractor's incentive to invest and reduce costs through learning curve improvements

- Encourage and facilitate VECP activities
- Institute fully loaded costing systems for government systems management, to ensure high quality management decisions based on full disclosure of total costs
- Begin to record learning curve data to expand the knowledge base for future decision-making
- Convert award selection criteria from "instant contract bid" to "best value" and "full life cycle cost" in support of current government objectives, and shift from "cost only" to readiness and quality as paramount procurement drivers.

4.2.2 Investment

The objective of this section is to discuss the advantages that industry systems management may offer the Government with regard to investments needed throughout the life cycle of a typical ammunition program. The various needs and sources of investment (whether funded by Government, industry, or both) necessary to achieve successful ammunition programs are also addressed.

The investments for ammunition programs fall into three categories—technology or development, production or process, and cost reduction.

The technology or development investments include industrial funds spent hiring, training, and supporting technical and program management staffs; developing and facilitating engineering laboratories and test facilities; supporting independent research and development programs; supporting bid and proposal efforts; buying capital equipment for the support of engineering programs; making profit investments in development programs for business reasons; advance releasing funds to provide for engineering program continuity during contract funding gaps; and supporting engineering change proposals.

The production and process investments include industrial funds spent hiring, training, and supporting technical and management staffs which support manufacturing and materials organizations; supporting and equipping manufacturing facilities; supporting production bid and proposal efforts; spending monies on capital manufacturing and material handling equipment, and on special tooling and test equipment; making profit investments or risk losses on production programs; advance releasing funds to provide production program continuity; and spending monies for acquisitions and license fees.

Cost reduction investments include industrial funds spent on value engineering change proposals and general cost reduction projects.

As a profit return on these investments, industry receives a "payoff" or reward in terms of money, which in turn enables industry to sustain or grow the ammunition development and production business. This "payoff" can be expressed in many ways such as profit, return on investment, shareholder value, etc. In this report, the word "payoff" simply expresses the reward industry expects for investing in its business.

By virtue of this payoff, industry systems contracting and its corollary investment commitment from industry offers several benefits to the Government:

- Adds market stability, thereby helping the Army to meet its readiness objectives
- Increases the contractor's stake in the product, thereby increasing the quality of howitzer ammunition produced and delivered
- Leads to more willingness to invest, thereby reinforcing learning curve improvements and decreasing ammunition production costs accordingly.

The remainder of this section will present background perspectives regarding investment, trends and analyses discussions, and conclusions and recommendations.

Background

The life cycle of ammunition programs generally follows this sequence:

- Need Recognition
- Concept Definition
- Advanced Development
- Full Scale Engineering Development
- Transition to Production, Production Engineering, and Low Rate Initial Production
- Full Scale Production
- Product and Process Improvements, Cost Reduction Initiatives.

If accomplished completely and correctly, each life cycle step requires a willingness by industry, Government, or both to make an investment commitment (both in quantity and duration) commensurate with the needs of the program phase. All such commitments are made with the clear expectation that the payoff will greatly exceed the level of investment.

Investments are never made, or are discontinued, without the expectation of payoff. Progress in howitzer ammunition can take many forms (improved probability of target hit, improved probability of target kill, safety, reliability, quality, cost reduction, and many others), but such progress only occurs when the investment needs of industry during each life cycle step are satisfied. Ammunition improvements such as ICM, DPICM, ADAM, FASCAM, Copperhead, and SADARM are directly traceable to investments in each life cycle step. Omitting the investment in any given step, or inadequate investment, jeopardizes the program payoff to the Government and the monetary payoff to industry. Insufficient funding for development or transition to production by the Government can create as much programmatic damage as a contractor unwilling to invest in technology, process improvements, or cost reduction.

The timing and duration of investments can also be critical to program success. For example, industry's recognition in 1960 that the principal barrier to applying electronics to howitzer-delivered mines was the lack of small reserve batteries. Technology investments in the early 1960s in reserve batteries enabled the fielding of ADAM and RAAM mines in the mid-1970s. Similarly, the industrial investments in all-weather, day/night sensor technologies in the early 1970s will enable fielding SADARM in the mid-1990s. These IR&D and profit investments were critical milestones in assuring the success of these ammunition programs. Investments are made at levels ranging from 2 percent to 4 percent for most systems-oriented companies, and these levels normally exceed the levels approved by the DoD.

The sources for industrial investments, irrespective of life cycle phase, can be traced to either overhead accounts or profit accounts. Because production program funding greatly exceeds the funding available for development programs, the principal source of industrial investment funding derives from the overhead and profit segments of production programs. Without production programs, no industrial contractor has the available finances necessary to invest in future technologies, productivity improvements, or cost reductions. Because of this dependence by industry on production programs for their investment base, the government's acquisition strategy for production programs can have a direct and substantial impact on contractors' perception of future investment payoff. A contractor will make investments to achieve a future production program payoff when he has a major stake in the program (i.e., as a systems contractor or manager), and has a reasonable expectation that he will continue to be a participant in the program.

Trends and Analyses

First, we will examine trends occurring in the various types of industrial investment made for ammunition programs. Next, we will discuss these trends in the aerospace and defense business in general, and what these trends may signify relative to industry's willingness to invest in the ammunition business. Industry systems contractors make investments in each of the following categories:

- **Technical and Program Management Staff** — As howitzer ammunition technology becomes more diverse and complex, there is a corresponding need for the maintenance within industry of trained, professional engineering staff. With the funding of new programs being limited, it is important for industry to invest wisely in those capabilities required for new ammunition products. The SADARM program is a good example of this. Since ammunition programs such as SADARM require highly specialized engineering skills and since there are fewer programs to pursue, it is becoming increasingly difficult for industry to maintain large, or even adequate, technical staffs. Moreover the complexities associated with managing large ammunition programs will continue to require that industry have a full time, professional program management staff available and in place for programs such as SADARM and next-generation howitzer ammunition. Teaming, joint ventures, or subcontracting specialties will be required to minimize investment in technical staff.

- **Engineering Laboratories** — To support the technical and program management staffs, industry also invests in a broad variety of technical laboratories covering the spectrum from composites, explosives, and propellants to sensors and processors. Although most ammunition contractors utilize government-owned facilities for testing howitzer ammunition, many systems contractors have invested in their own privately owned test facilities. This assures rapid availability of test results during development programs and/or rapid lot acceptance testing for manufacturing operations. Although most ammunition contractors utilize government-owned LAP facilities, industry has invested in privately owned LAP facilities in many cases. This assures tighter control over both the cost and the quality of ammunition programs.

- **Independent Research and Development (IR&D)** — Generally, a contractor's technological capabilities are funded either from development contracts or as a portion of the general overhead structure called Independent Research and Development. Since only part of the technology base funded by IR&D is allowed in the general overhead structure, the remainder is funded from contractor profit depending on the value placed by the Government on the contractor's IR&D program. Many of the advancements in U.S. howitzer ammunition can trace their origins directly back to industrial IR&D

projects. Typical levels of IR&D funding by ammunition contractors is 2 to 4 percent of their total sales. Figures 4-17 and 4-18 illustrate this worldwide trend.

- **Bid and Proposal (B&P)** — Like IR&D, bid and proposal costs are also partially funded in the general overhead structure of a contractor. Because the size of the general overhead allowable costs are fixed, expenditures beyond the bid and proposal ceiling are all borne by the contractor's profit. Typical levels of B&P funding by ammunition contractors are also about 2 to 4 percent of their total sales.

- **Capital Equipment** — With very few exceptions, the Government has removed itself from investing in general purpose engineering or manufacturing (capital) equipment. Since the programmatic need for such equipment continues to exist, the only available source of investment is the contractor. The accounting for investments in contractor capital equipment is generally absorbed in either engineering or manufacturing burden rates. But again with a preponderance of fixed price contracts, such investments are equivalent to profit investments. This is also the case for contract investments made by DoD's suppliers. Both of these trends are shown in Figure 4-19.

- **Special Tooling/Special Test Equipment** — Engineering or manufacturing equipments which are unique to a specific program generally fall into the categories of special tooling or special test equipment. Although the Government will generally allow the amortization of these unique equipments into development or production contracts, the initial outlay for such equipment costs is usually borne by the contractor. For competitive or programmatic reasons, a contractor may elect to invest fully in special tooling or test equipment without amortization into a government contract.

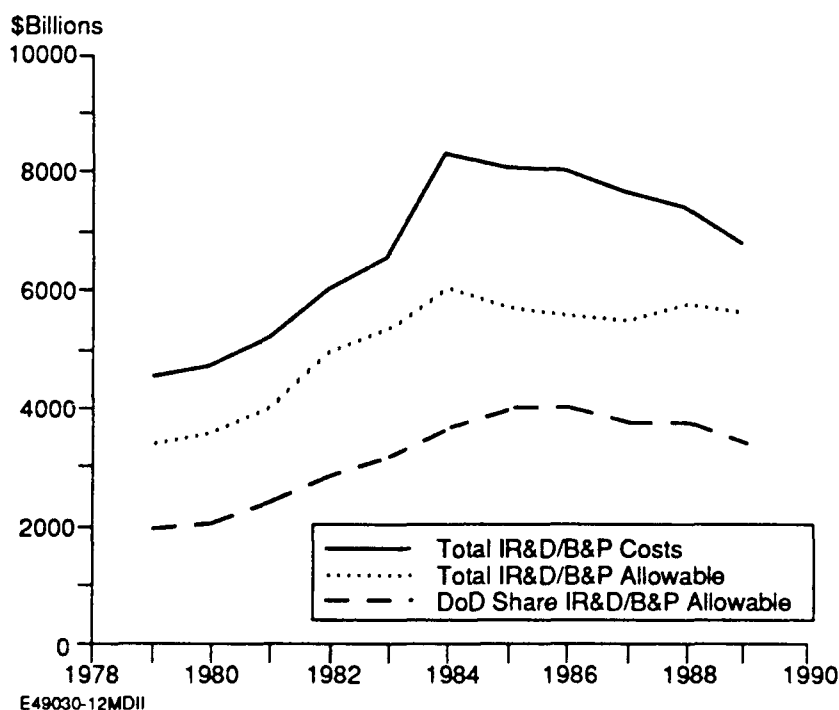


Figure 4-17. IR&D/B&P expenditure and allowable cost trends, 1979-1989 (billions of constant 1988\$). (Source: Lopez and Vadas, "A Global Perspective for the 1990s," *The U.S. Aerospace Industry*, AIAA, Inc., p. 101, January 1991)

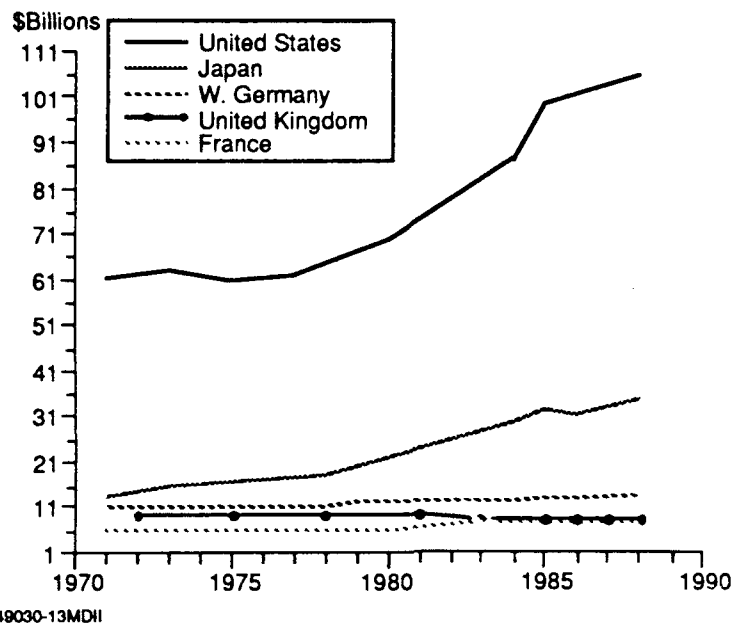


Figure 4-18. International comparisons of R&D expenditures, 1971-1988 (billions of 1982 \$). (Source: Lopez and Vadas, "A Global Perspective for the 1990s," *The U.S. Aerospace Industry*, AIAA, Inc., p. 112, January 1991)

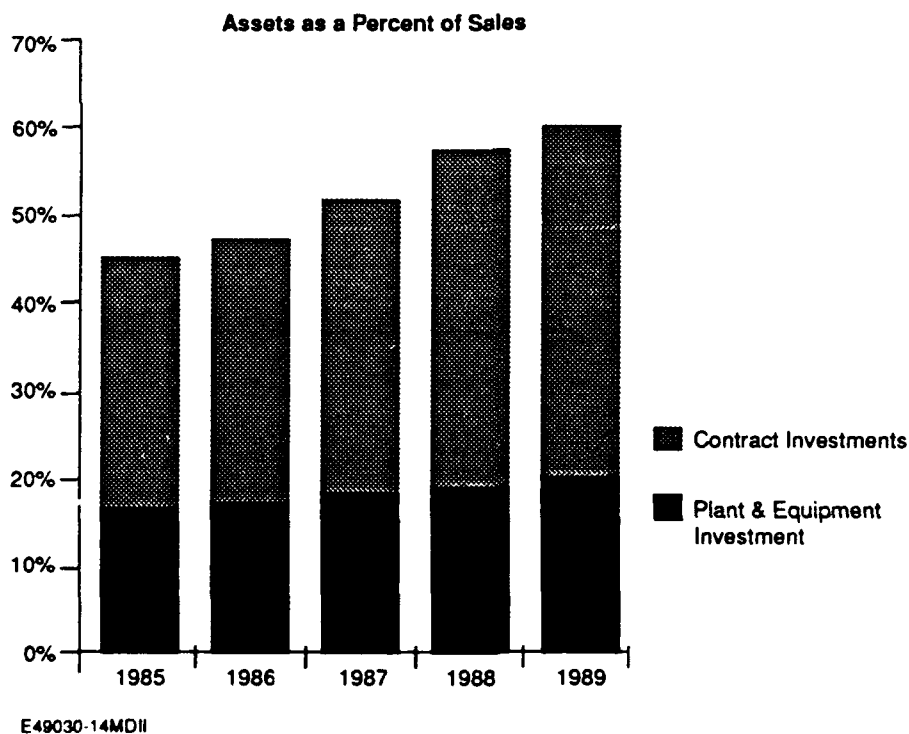


Figure 4-19. DoD suppliers' investments. (Source: Defense Segment Data of S&P Aerospace Index Companies.)

• **Advance Releases** — When the Government encounters budgeting or administrative delays such that contract funding for a program may not be available in a timely manner, contractors may elect to assure program continuity and minimize program cost increases by advancing their own profit funding until government funds become available. Although fully recoverable in most situations, such funding represents both a profit risk to the contractor and potentially a serious cash flow drain. Funding the continuation of large production contracts over an extended period of time can represent a multimillion dollar cash flow impact.

• **Engineering Change Proposals (Product Improvement)** — During the execution of production contracts, a contractor may find ways of improving a product (even if it does not represent a cost reduction). In such cases, a change to the Technical Data Package (TDP) is required. The vehicle for making such changes is an Engineering Change Proposal (ECP). Although the costs for defining, proving, and proposing changes to TDPs are fully borne by government contracts when the ECP is approved by the Government, time delays in negotiating the inclusion of such ECPs into a contract can represent a serious cash flow problem to a contractor. Contractor-proposed ECPs which are not approved by the Government for inclusion in production contracts can represent a direct profit loss to the contractor.

• **Value Engineering Change Proposals** — In all cases, Value Engineering Change Proposals represent a product cost reduction, and both the Government and the contractor share in the financial benefit. However, the Government often has difficulty in adequately funding VECP efforts. Since the Government typically does not budget for VECP activity, funds may not be available for good cost reduction ideas with the consequent result that approval and implementation is frequently delayed or, in some cases, approval is never granted. Value Engineering Change Proposal costs are borne by the contractor until the Government approves and implements such changes in their production contracts.

• **Cost Reductions** — Industry also invests in cost reductions other than those which require a change to the TDP or qualify as Value Engineering Change Proposals. Such cost reduction activity is typically funded by contractors out of engineering or manufacturing burden, or profit. A typical example of this type of cost reduction is manufacturing process improvements such as Just In Time inventory control, Statistical Process Control, or the implementation of Total Quality Management on a manufacturing line.

Historical and Current Trend Considerations: During the various wars of the first half of the twentieth century in which the United States was involved, the Government essentially bore the expense of investments for the ammunition technical and production bases. In the case of the less sophisticated howitzer ammunition rounds, this is still generally the case—but even howitzer ammunition is experiencing many forces of change as discussed in the Background section of this report.

Government funding to support the ammunition technology and production bases is declining. As far back as 1987, before the drastic downsizing of the DoD budget began, the Senate Armed Services Committee (SASC) was concerned that the U.S. could lose its qualitative advantage over potential adversaries due to decreases in DoD investments in the defense industry technology base. "The U.S. technology base represented 1 percent of total U.S. DoD obligations in FY88 versus 3.1 percent in FY65. The investment decline has led to a \$3 billion high technology trade deficit in 1986 versus a \$30 billion surplus in 1980."⁴ Many of the dedicated and experienced people employed in these bases, both by the Government and industry, are retiring and not being replaced. The incentives for new talent to enter these

⁴ "Article," *Aviation Week*, p. 21, 18 May 1987.

jobs are also declining, which only adds to the decline of the technical and production bases which support howitzer ammunition.

One key to successful restructuring of the howitzer ammunition base will be how well the Government and industry plan for future needs which require significant investment by industry. Another key will be how to synergize the remaining assets of both Government and industry, and apply them to future ammunition developments.

Defense-committed industries need to have a clearer definition of where the DoD and Congress are headed before significant future investments are made. To commit future investments in the howitzer ammunition segment, the defense industry needs to know that the Army and DoD are committed to a partnership wherein significant industrial investments have the potential to satisfy government needs while providing the assurances of payoff so essential to industrial investments.

Conclusions

With regard to industrial investment, we can conclude the following:

- Breakout contracting increases industry risk of losing program positions, and thus tends to destabilize programs and reduce incentives for investment. Table 4-30 summarizes these investment incentives in the context of breakout versus systems contracting.

- All of the investment categories described above directly benefit government programs and, in most cases, are absolutely necessary to the success of these programs. Additionally, many such investments are a direct source of savings to the Government especially when aggressive cost reduction investments do not negatively impact the contractor's cash flow or profitability. As stated previously, contractors will continue to invest in any or all of the categories listed above as long as they continue to believe that the expected payoff will significantly exceed the level of investment.

- Within industry, the "invest-to-uncertain" payoff trend has already stopped because industry cannot survive in the defense business without expectations of reasonable returns on their investment. Thus, the Government has an imperative to adjust their control of industry involvement in the defense business or lose a valued resource at the expense of a weakened defense posture. By encouraging and using industry systems management more broadly, the Government is taking a step in the right direction to retain industry involvement in the defense business.

- Given an opportunity and a potential payoff, industry systems contractors will invest heavily in the programs which they are selected to manage throughout all phases of the program life cycle. Although the Government allows recovery of a good portion of these investments, industry system contractors do invest a large portion of their profits in the programs they manage. They certainly do not invest in programs in which they do not have the opportunity to be a key player.

- With respect to readiness, industry systems management offers an advantage over government systems management (breakout), again across all phases of the life cycle. The timeliness of winning systems management programs is clearly tied to the timeliness of various investment phases for that program. It is a well-established fact (120mm Tank Ammunition, ADAM, SADARM, etc.) that the IR&D, B&P, capital, technical staff, and advance release investments were key to keeping major system programs on schedule.

Table 4-30. Investment—breakout versus systems procurement

Investment Category	Breakout	Systems Contracting
Technical and Program Staff	Minimal in build-to-print low-overhead shops	Yes—integral part of “full service capability”
Engineering Laboratories	No	Yes—integral part of “full service capability”
IR&D	No—requires technical staff	Yes—integral part of “full service capability.” Level normally exceeds allowable ceiling and is funded by profit
Bid and Proposal (B&P)	Yes—cost estimating B&P	Yes—cost estimating, engineering, and program management B&P
Capital Equipment	Minimal—use hand labor at minimum wage	Yes—where justified. Enhanced quality and surge capability
Special Tooling and Test Equipment	Minimal required	Yes—integrated into SPC
Advance Releases	Minimal, due to marginal capitalization	Yes—major stake in program continuity, just like the Government
Engineering Changes and P3I Improvements	No—requires technical staff, which would increase costs and impact bid competitiveness	Yes—the key to next generation products to maintain market share
VECPs	No—requires technical staff	Yes—source of profit, cost reduction, and quality improvement
Cost Reductions	Yes—(for production process only) as much as needed to retain business. Cost reductions affecting quality level (still within specifications) may impact system performance	Yes—key to keeping costs controlled while improving quality

- With respect to product quality and the trend toward certification, industry will make the necessary investments to be certified if they wish to continue to be defense contractors. The key to success will be to enable industry to manage programs with a reasonable expectation of control and of payoff for their work and investments.

Recommendations

Based upon the preceding analyses and conclusions, we offer the U.S. Army the following recommendations:

- The U.S. Army should encourage defense industrial investments for howitzer ammunition by utilizing those contractors (i.e., industry systems contractors) whose long range business strategies include the development and production of ammunition products as a core business, and who can convince their shareholders that the defense business opportunity warrants these investments.

- The U.S. Army should decide early in the life cycle of a product the extent of anticipated industry involvement, since industry will invest only where a reasonable payoff can be expected.

- The U.S. Army should assure system contractors that their investments are recognized by the Government as a competitive "plus" for the ammunition business. Bid evaluations which ignore the investments made by systems contractors and favor price-only competition discourage investment.

- The U.S. Army should evaluate existing government and defense industry capabilities and facilities for redundancy and/or synergy. Future government/industry investment should minimize overlap or redundancy to conserve funds. Contracting vehicles which enable industry system contractors to utilize and improve government facilities should be used wherever possible to minimize unnecessary investments.

4.2.3 Schedule

The objective of this section is to identify schedule-reducing techniques and advantages to the Government that can be realized by contracting for howitzer ammunition systems management with industry.

Development, production, and operational schedules are set by the government. Key dates, for comparison purposes in this section, are the decision date to start development for an ammunition item to be fielded and the date specified for initial operational capability (IOC), where a sufficient quantity of production has been delivered to field the intended performance capability of a specified weapon system. One measure of performance is consistent timely delivery. The optimum use of available resources in government and industry requires that both work together to effect timely fielding of needed ammunition. This includes meeting IOC dates, customer requirements, and inventory objectives.

True schedule optimization is viewed as a way to save money for the Government. Therefore, the schedule driver has great importance both from procurement cost and total cost point of view. Some of the operating flexibilities available to industry which are not always available to the Government can be utilized to the government's advantage to optimize schedules and save money through industry systems

management contracting. These advantages include the ability to shorten schedule periods and to advance release program funds, which reflect the importance of schedule flexibility and continuity. This section addresses some of these schedule-shortening and optimizing techniques.

Background

The two basic schedule issues are flexibility and continuity. Schedule flexibility includes the ability to accelerate and decelerate as the environment requires. The criticality of schedule varies from time to time, and is often threat-driven. Ideally, future threats are identified and responded to with customer requirements that will defeat or neutralize the threat. At times, the government's strategy may be to develop and field ammunition which can counter a potential enemy threat that has appeared sooner than expected. At other times, the strategy may be to leap ahead with "surprises" to upset an enemy's fielding plans for new weapon systems. Schedules normally become extremely critical when these situations occur.

Program continuity is extremely important for purposes of cost efficiency and control on various ammunition programs. Ideally, budgets for ammunition procurement (component build and load, assemble, and pack) are scheduled and funded in a timely fashion, and continuous production using trained people is sustained year after year until inventory objectives are met. In reality this budgetary and planning system has many possibilities for disruption. Timely funding decisions from Congress are not always made. Weapon system platform development schedules can be perturbed and affect related ammunition requirements, and a host of other possible interruptions frequently occur.

To examine how the government can benefit in schedule flexibility and continuity from industry system management of ammunition development and production, we analyzed the development cycle for developing, producing, and fielding several rounds of 105mm tank ammunition which were government system-managed with several rounds of 120mm tank ammunition which were industry system-managed.

The investment of funds by contractors provides one example of the flexibility that exists in industry to sustain program continuity. The investment examples discussed below reflect the contractor's cost of money investment and cost avoidance realized by advanced releasing funds prior to contract funding. The 120mm program is used to illustrate the positive schedule impacts. The ADAM program is used to demonstrate that advance releases can partially aid a government systems-managed program, though only to the extent that the component being procured is supplied by the prime contractor. In a government systems-management environment, each of the component contractors would have to be willing to make these investments to impact the overall program continuity. Industry systems management places that responsibility on a single competent, financially responsible system prime contractor.

Trends and Analyses

The following discussion provides examples of where industry system management has benefited the Government by enhancing schedule performance. Since no ammunition program has been managed both by the Government and by industry, there was no "control" sample to investigate. In lieu of this control sample, we compared development-to-IOC schedule cycles of several 105mm tank ammunition rounds with those of the 120mm tank ammunition rounds. The 105mm rounds (M735, M774, M833) were developed over a 10-year period, with average development-to-IOC taking seven years. The 120mm

rounds (M829, M830, M831, M865) were developed over a six-year period, with average development-to-IOC taking five years.

There were several factors that helped to compress the fielding schedule of the 120mm rounds. A proven German-designed baseline of similar 120mm rounds was available at the onset of the program. The U.S. program was a technology transfer, fabrication, and test program which duplicated key processes and incorporated design changes necessitated by American requirements to meet the fielding requirements for the M1A1 Abrams tank weapon system. This was both an advantage and a disadvantage. The advantage derived from the proven nature of the training round designs. The disadvantage derived from the necessity to change from German to American manufacturing processes. The 120mm tactical rounds had to be re-designed and tested to meet American requirements, which were more stringent than German requirements. This redesign/test effort increased program schedule risk, but was accomplished in a timely manner.

The U.S. Army gave full responsibility for ammunition and gun development and fielding to the Tank Main Armament System (TMAS) program office at Picatinny Arsenal. Though TMAS utilized government personnel at their development laboratories for program support, they solicited competition from private contractors to serve as an industry system manager working for the Government to field the ammunition. After bids were solicited and evaluated, Alliant Techsystems Inc. (formerly Honeywell Inc.) and TMAS forged a very strong U.S. Army/industry team, which worked very closely with Rheinmetall, the German developer, to meet the customer fielding requirements.

The 120mm program serves as a classic example of the benefits of industry systems management to the U.S. Army. As industry systems manager, Alliant Techsystems managed the American technical data package, the development, testing and process work, along with the subcontractor network, to accomplish:

- Type classification of new U.S. 120mm ammunition — 4 rounds in 4 years
- Production of sufficient quantities of ammunition for tank fielding — 4 rounds in 5 years.

In addition, three test and development ranges were brought on line by the industry systems manager that were dedicated to the 120mm program. This minimized scheduling problems and provided rapid turn-around for the development process. Also, the industry systems manager brought to the program the personnel required to support and manage the development process at subcontractor locations in-country, and worked successfully with Rheinmetall to transfer the German technology to the U.S. technical base. This resulted in successful duplication and enhancement of the ammunition performance for the U.S. requirements.

During the 120mm development-to-IOC cycle, the industry systems manager advance released (obligated) more than \$50 million to maintain program continuity at the systems contractor level and within the subcontractor network. This was necessitated due to delays in the government funding cycle that would have cost the U.S. Army more than an eighteen-month schedule delay on its number one priority weapon system program.

Another comparison of 105mm and 120mm counterpart round development-to-IOC cycles is provided by the XM900E1 and M829A1 production improved tank ammunition rounds:

- 105mm XM900E1 = 73 months
- 120mm M829A1 = 41 months.

The fielding of the M829A1 round in 41 months (versus 73 months for the XM900E1) is considered by Army and industry personnel as an extremely short time period for fielding a round of this type. While the round development was industry system-managed, the success is considered by the Army customer to be an excellent example of government/industry cooperation and achievement.

As a combined government/industry management effort which met stringent fielding schedules in record time, the M829A1 program clearly demonstrated the benefits to the Army of achieving the desired IOC dates. The contract was performed on time and with cost underruns. The round was fielded when needed—IOC was eight months earlier than originally scheduled. Some of the M829A1 program attributes were as follows:

- The time of the development cycle was minimized because of the following:
 - Design of Experiments method was used to rapidly close on the key design parameters.
 - Performance goals (TID, penetration) were demonstrated early—in seven iterations rather than the planned nine or ten.
 - Program planning involved all major component subcontractors.
- There was a willingness to take risks on the part of the Government and the industry systems manager.
 - Design/build/test iterations were “leapfrogged” or overlapped to compress schedule.
 - Multiple designs were built simultaneously if a decision wasn’t initially clear.
 - Government was willing to accept contractor test data.
- Early producibility activity was initiated by the industry systems manager.
 - Intentionally testing product built beyond allowed tolerances.
 - Conducting tolerance studies and funding machining studies at subcontractors.
- Facility development was controlled by the industry systems manager to ensure compatibility with the product design.
- TMAS served as program “champion” by insisting on timely response from other government agencies when required.
- Timely testing was conducted at contractor-provided test range, allowing contractor to set own priorities.

With regard to production, advance releasing has been vital to the Army for the past 10 years in maintaining schedules to prevent congressional budget reductions due to perceived slips into the next fiscal year (and the next budget). The financial impact of advance releases and cost avoidance to the Government for the 120mm tank ammunition and ADAM mine programs is shown in Figure 4-20. The ADAM program is cited only to show that even for government systems-managed programs, significant involvement by a systems contractor can result in appreciable schedule shortening and cost saving benefits to the Government.

The examples described above provide a limited view of industry system management support to the government. Nevertheless, they clearly demonstrate industry systems contracting advantages which

Contractor's Cost of Money (COM) Investment

	Years	Number of Contracts	Total Advance Release \$ Committed	Cost of Money (COM) Investment
120mm	1980 - 1990	10	\$219 Million	\$27 Million
ADAM	1979 - 1990	13	\$252 Million	\$9 Million

COM Investment = Advance Release \$ x COM Rate of 15% x Months Covered (12)

Cost Avoidance by Bridging Production Funding Gaps

	Number of Gaps Bridged (1)	Total Production \$ without Gaps (2)	Total Production \$ with Gaps (2)	Cost Avoidance
120mm (3)	3	\$1,020 Million (4)	\$1,314 Million	\$294 Million
ADAM	4	\$1,020 Million (4)	\$1,291 Million	\$271 Million

- (1) Based on funding gaps covered by advance releases for periods in excess of six months for the contracts enumerated in the Cost of Money (COM) investment chart above.
- (2) Production totals for above contracts escalated to FY90 dollars. Totals do not include non-recurring costs.
- (3) Excludes TTF&T contracts.
- (4) The identical total for each program is coincidental. Any way that the Government can streamline the funding cycle (i.e., through multiyear contracts, long lead contracts, etc.) will help minimize this need.

Figure 4-20. Financial impact of advance releases and cost avoidance for a typical industry systems contractor

enabled the Government to field important capabilities in a timely manner. This coupling of the government's objective of fielding the best tank system capabilities on a tight schedule, and industry's monetary incentive to succeed, synergized to result in a very successful program.

Conclusions

With regard to scheduling considerations, including timeliness, flexibility and continuity, we can conclude the following:

- When Government has a very stringent schedule requirement to field their top priority weapon system capability, industry systems management offers the best likelihood of success in meeting schedules for both ammunition development and production. Industry, when motivated as a systems contractor, has repeatedly demonstrated the capability and flexibility to respond to development cycle requirements on both tech transfer and new development rounds.

- The technical base for new ammunition technology can best be established jointly. When technology transfer from abroad to America is required to establish the technical base and meet mission needs, industry systems management is the optimum procurement strategy, because it facilitates more timely transfer of technology.

- Judicious sharing of resources within the Government and industry enable the government/industry system management team to meet schedule. The industry systems manager can more easily bring on line special development laboratories and test ranges specifically dedicated to the program. Industry also has the advantage of flexibility in hiring practices, capital spending, advance releasing, etc., to accomplish the stringent schedule requirements.

Recommendations

Based upon the preceding analyses and conclusions, we offer the following recommendations to the U.S. Army:

- The U.S. Army should make major programmatic decisions as early as possible, regardless of whether industry or government systems management will be used for a new program. This will save valuable lead time for the government, and will stimulate prospective industry managers to make investments which support the program.

- The U.S. Army should utilize industry systems management for howitzer ammunition acquisition to the maximum extent possible. Government systems management should be used on an exception basis only, on programs with substantial history of proven timely production.

4.3 Total Quality Management

The objective of this section is to evaluate the effect of Total Quality Management (TQM) on the procurement of howitzer ammunition from a government systems management versus industry systems management perspective and to determine which method of procurement offers the "best value" to the Government from a TQM viewpoint.

In recent years, TQM has become a key contributor to successful product development, product manufacture, and product enhancement. TQM techniques have been successfully implemented on AMCCOM ammunition procurements through industry systems management. The 120mm tank ammunition program, for example, is systems managed by two industry contractors, both of whom have shown that industry can successfully apply TQM techniques to ammunition systems. TQM also provides a solid base for taxpayers to obtain "best value" in procurements.

TQM in this study focuses on four key elements: Customer Satisfaction, Concurrent Engineering, Continuous Improvement, and Contractor Certification. While pros and cons are presented for both procurement approaches, the study strongly supports a clear benefit to the Government of using industry systems management to leverage TQM and increase quality's importance on future ammunition procurements.

The remainder of this section presents a TQM background perspective, analyzes TQM trends in the Government and industry, and provides a set of conclusions and recommendations for U.S. Army consideration.

Background

TQM is the main initiative within the Government and industry for continuous improvement of all products and services. It is a philosophy that spans across all levels of an organization whose main goal is continuously improving performance. It combines numerous existing improvement efforts, along with various management techniques, in a structured approach to improve each and every process utilized in day-to-day operations. The impact of TQM on any given program can best be gauged by customer satisfaction—the complete fulfillment of all customer needs and expectations with regard to product quality, performance, delivery, and service.

TQM is currently being implemented through various government/industry quality initiatives including concurrent engineering and continuous improvement. Concurrent engineering is the systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and product support. Concurrent engineering reinforces the matching of user needs with end item producibility. Continuous improvement places emphasis on preventing defects through process improvement rather than detecting them through failures. The key element in improving a process is to begin early in the product and process life cycle, during initial definition and understanding. Incremental process improvements are then made and tracked to ensure the gains are held.

In one TQM-related area, Contractor Certification, AMCCOM is sponsoring an effort to certify qualified industry contractors on the basis of their performance, their quality programs, and other considerations. The Contractor Certification effort is a program which supports continuous process improvement and complements other programs within the Department of Defense (such as the DoD Manual on Transition From Development to Production, DoD Exemplary Facilities Program and the In-Plant Quality Evaluation Program). The Contractor Certification Program will standardize other DoD TQM efforts, such as CP², and will make the standards, metrics, and methods for certification validation more uniform.

The key issues regarding quality may be grouped according to the four major categories presented above. These issues include:

- Within the customer satisfaction area, the issues are:
 - Warranties are often based on workmanship only
 - Acceptance Quality Level (AQL) and Lot Tolerance Percent Defective (LTPD) goals allow a minimum level of nonconforming products

- Customer satisfaction is often viewed primarily in terms of cost and schedule
- Customer satisfaction is sometimes viewed too narrowly as being solely concerned with meeting the terms of contract (nothing more, nothing less).

- Within the concurrent engineering area, the issues are:

- Design and Manufacturing do not necessarily work together during development
- There is a minimal Quality involvement "up-front" in design and development
- Inspectability and producibility usually are not integrated during the design phase.

- Within the continuous improvement area, the issues are:

- Quality is often limited to defect detection and correction
- Quality is often based on performance trend analysis
- Improvement strategies have historically been step functional (ECP, VECP, PIP, P³I), which does not necessarily mesh with continuous improvement
- "Acceptable levels" of performance do not necessarily equate to continuous improvement.

- Within the contractor certification area, the issues are:

- Contractor Certification is an emerging concept, which has not yet been proven out or implemented in its latest form (Contractor Certification Program)
- Contractor Certification may or may not eliminate traditional redundant inspection by the Government after contractor acceptance.

Trends and Analyses

Following is a summary of the TQM trends that both the Government and industry are experiencing.

Within the customer satisfaction area, trends include:

- Warranty based on product performance
- Lower total cost/"best value"
- Continuous reduction of defects as central to increased customer satisfaction
- Conformance to correctly defined requirements, satisfying user needs
- Higher attention to customer feedback for determining changes to design and service.

With government systems management, the need to satisfy a customer is fulfilled upon delivery of a product to the Government. This means that once the Government takes control of the piece parts or subassembly from the contractor, the contractor is not concerned with how it performs at the next level. As long as it meets the acceptance criteria called out in the SOW, spec or contract, the contractor has met his obligation. There is greater potential for interface problems at the load plant since there is little coordination among the suppliers and subcontractors making the piece parts and subassemblies. This places the responsibility and liability on the Government for end item performance.

With industry systems management, the emphasis is on the life cycle of the product since the contractor is responsible for the entire end item. The need to satisfy the Government is very high on the

contractor's priority list since the systems contractor has overall responsibility. However, a potential problem could arise if one government agency indicates the need for a design improvement while another agency opposes such an improvement under the circumstances. The industry systems management contractor may be unable to attain resolution without brokering by the Government.

Industry systems contractors also utilize other key tools for customer satisfaction assurance, including Quality Function Deployment (QFD). This is a set of key Japanese quality tools and techniques, sometimes referred to as "the house of quality," due to the shape of the matrices employed in the analytical methodology used to establish system characteristics. These QFD techniques, which were embraced totally by firms such as Toyota after their shipbuilding and automobile rust-out experiences, assist in requirements allocation and definition to ensure proper attention to true customer wants rather than industry custom. QFD is another important TQM tool which can only be exploited at the system level by a tightly focused team.

Within the concurrent engineering area, trends include:

- Inspectability and producibility integrated more closely with design efforts
- Design To Production Transition stressed as pivotal to product performance and success
- Quality involvement emphasized early (during requirement determination)
- Quality designed and built into the product and processes.

With government systems management, concurrent engineering practices are not as widespread within either the Government or the component contractors. For concurrent engineering practices to be implemented more widely, the Government would need to maintain a staff of qualified engineers to assume responsibility for overall system integration and technical evaluation during developmental efforts. Each functional discipline would be required to interface with their industry counterparts at each component contractor to achieve coordination and joint resolution of problems.

With industry systems management, concurrent engineering plays a more vital role. The system contractor can work overall product enhancements more readily than component contractors, while still reducing life cycle costs. It is also more efficient to make the improvements with all the functional engineering specialties represented at the system contractor's facility. The various levels of expertise needed by an industry systems manager can also be maintained and shared across programs (both military and commercial).

Within the continuous improvement area, trends include:

- Reduced program cost through measurement and improvement of all business processes
- Statistical Process Control institutionalized as a mainstay of product manufacturing
- Training and empowerment of employees emphasized
- Continuous improvement strategies infused into the company culture.

Continuous improvement through TQM application can exist with either of the two acquisition approaches—industry systems management or government systems management. A major advantage industry systems management has over government systems management in this area is that improvements can be realized in a more integrated fashion. Government-managed component contractors generally are restricted to concentrating their efforts on the part/subassembly, while industry systems contractors have the opportunity to focus on the entire system (possibly even eliminating or combining some of the subassemblies).

The industry systems contractors are more inclined to invest time and money in improvements, since they would have better opportunity to regain their investment over the life cycle of the product. As Deming's 1st of his 14 Management Points (Constancy of Purpose) would support, a long term investment can be realized given the opportunity for continued or expanded business. Industry has the incentive to continuously improve because of the business necessity to stay competitive and to keep the product in production longer through product enhancements.

Within the contractor certification area, trends include:

- Relationships based on trust and confidence in contractors' systems
- Focus on processes rather than end item inspection
- Involvement of all functional disciplines during development phase to maximize producibility and minimize cost
- Product accepted by the Government based primarily on contractor's certification
- Major thrust on continuous improvement of all processes.

The Contractor Certification Program has the potential of having a major impact on future government/industry relationships. The program envisions significant reductions in traditional government oversight. At the same time, industry will be required to exercise increased control over its processes, as well as increased control over its suppliers and subcontractors. The program builds on current continuous process improvement initiatives under the TQM umbrella and represents a major enhancement to TQM.

In the future, certification may be required on all major procurements. Certification will assure that a contractor is applying TQM principles. The industry systems management approach is totally consistent with the principles of the certification program. The industry systems management contractor will establish and maintain a certified subcontractor base. From a government standpoint, this holds a single contractor responsible for systems certification management, rather than the Government establishing and monitoring certification efforts for numerous government-management component contractors. Also, as understood by industry, subcontractors certified by contractors will also be accepted by the Government, thus saving the Government the expense of doing their own redundant certification.

In summary, the advantages of TQM implementation for both procurement approaches are listed in Table 4-31. The obstacles to TQM implementation are similarly listed in Table 4-32. The main thrust of these two tables and their supporting analyses is that industry systems management offers greater likelihood of successful TQM implementation on future ammunition procurements.

Conclusions

Comparing government systems management with industry systems management, we believe that the latter offers more potential for total quality to be realized and implemented on future howitzer ammunition procurements.

Industry systems management offers the U.S. Army a single point of responsibility and accountability for quality management (i.e.: integration/LAP, LAT, and performance/warranty). The industry systems management contractor is more motivated to increase quality and reduce costs, by improving both the product and the schedule, since there are more financial incentives to do so.

Table 4-31. TQM implementation advantages—government systems management versus industry systems management

Government Systems Management	Industry Systems Management
<p><u>Customer Satisfaction</u></p> <ul style="list-style-type: none"> • Government has direct control over entire planning process • Government procuring agencies might be more responsive to user needs since they are part of the DoD complex • Government has most of the essential facilities (proving grounds, laboratories, etc.) for quick resolution of problems 	<p><u>Customer Satisfaction</u></p> <ul style="list-style-type: none"> • Systems contracting offers single point accountability/liability for performance (warranty) • Systems contracting offers single point manager of end item (funds, schedule, design, LAP/LAT) • Systems contracting offers less cycle time for product acquisition (contractors can advance release to maintain schedule) • Systems contractors are financially motivated to improve product delivery/performance
<p><u>Concurrent Engineering</u></p> <ul style="list-style-type: none"> • No apparent advantages 	<p><u>Concurrent Engineering</u></p> <ul style="list-style-type: none"> • Systems contractors can more easily facilitate product enhancements • Reduces life cycle costs for subcontractors, systems contractors, and the Government
<p><u>Continuous Improvement</u></p> <ul style="list-style-type: none"> • No apparent advantages 	<p><u>Continuous Improvement</u></p> <ul style="list-style-type: none"> • Systems contractors have profit and competitive motives to reduce costs through continuous improvements to the product and business processes • Systems contractors possess the total product/process knowledge, which enables them to simplify the continuous improvement process
<p><u>Contractor Certification</u></p> <ul style="list-style-type: none"> • Government has one less layer between user and component-level contractor 	<p><u>Contractor Certification</u></p> <ul style="list-style-type: none"> • Systems contractors, especially if certified, require much less government oversight

Table 4-32. TQM implementation obstacles—government systems management versus industry systems management

Government Systems Management	Industry Systems Management
<u>Customer Satisfaction</u> <ul style="list-style-type: none"> • Government can impose only limited warranties upon component-level contractors • Government can realize only limited product enhancements from component contractors • Government assumes systems responsibility and after-sales service 	<u>Customer Satisfaction</u> <ul style="list-style-type: none"> • Government has less control over critical components and subcontractors • Systems contractors may have problems with accessibility to government test sites and facilities
<u>Concurrent Engineering</u> <ul style="list-style-type: none"> • Government has diminishing experience in development engineering (and hence concurrent engineering) due to recent trends towards contracting the majority of development work to industry 	<u>Concurrent Engineering</u> <ul style="list-style-type: none"> • None
<u>Continuous Improvement</u> <ul style="list-style-type: none"> • There is less incentive for component contractors to invest for improvements • There is limited product enhancement capability with component contractors • There is more work for Government to implement TQM (not in consonance with manpower reduction efforts) 	<u>Continuous Improvement</u> <ul style="list-style-type: none"> • None
<u>Contractor Certification</u> <ul style="list-style-type: none"> • Government has to increase its involvement with subcontractors to implement the certification process • Government has to maintain a staff of qualified technical personnel (not in consonance with manpower reduction efforts) 	<u>Contractor Certification</u> <ul style="list-style-type: none"> • Government has to rely more on trusting systems contractors to deliver a conforming product

Recommendations

Since certification would require contractors to aggressively and steadfastly apply TQM principles, eventual certification should be a goal of selected industry systems management contractors. Certification would thus offer cost savings to the U.S. Army in the form of reduced government oversight costs and would allow the U.S. Army to proceed with its goal of reduced micromanagement of ammunition procurements.

SECTION 5 CONCLUSIONS AND RECOMMENDATIONS

Over the past twenty years, the defense acquisition process has been studied, investigated, and reformed many times. With the current decline in defense spending, we must once again scrutinize the process and determine if improved practices should be adopted. The objective of the Howitzer Ammunition System Procurement study was to identify the advantages to the Government of using industry to perform the role of systems manager on munition development and production programs. The purpose of this section is to present summary conclusions and recommendations, and to offer selection criteria for using industry systems contracting.

5.1 Conclusions and Recommendations

Detailed analyses of factors that must be considered when contrasting government and industry systems management approaches were presented in Section 4 of this report. Our basic approach was to evaluate those drivers believed to influence the ability of a product systems manager to perform the systems management function during development and production. Those drivers considered in the evaluation fell into three basic categories—Readiness, Cost, and Quality—and included the following:

- Readiness
 - World and U.S. Budget Environment
 - Acquisition Policy and Political Considerations
 - Product Management, Requirements, and Improvements
 - Technology Base
 - Mobilization Base Readiness
 - Foreign Sales Considerations
- Cost
 - Total Cost
 - Investment
 - Schedule
- Total Quality Management.

Table 5-1 provides a complete set of conclusions and recommendations for each acquisition driver listed above. The main conclusion and recommendation: industry systems management is good for the Government and the Army, therefore the U.S. Army and AMCCOM should encourage industry systems contracting (versus breakout) for future howitzer ammunition development and production programs.

5.2 Product Life Cycle Implications

Based upon our analyses and conclusions, we determined that industry systems management offers significant advantages throughout the life cycle of a munition system, with the most obvious benefits realized during product development and production. In the broadest sense, industry systems management can help preserve the ammunition readiness base for U.S. national security, reduce total acquisition cost, and improve product quality.

Table 5-1. Conclusions and recommendations

Conclusions	Recommendations
World Environment and U.S. Budget	
<ul style="list-style-type: none"> • The DoD budget, the O&M budget, and the Army ammunition budget shrank in the late 1980s, and will shrink considerably further in the 1990s. • Government staffs, including Army and AMCCOM procurement staffs, have begun downsizing and will continue to do so in the mid 1990s. • Government personnel capacity for ammunition systems integration and management and for procurement of subsystems and components will be reduced accordingly. • The U.S. has been gradually moving away from government production of munitions; our closest allies have been accelerating this transfer even faster. Privatization of ordnance production will continue and accelerate, both globally and domestically. 	<ul style="list-style-type: none"> • For most howitzer ammunition rounds, the U.S. Army should utilize systems contracting with industry to reduce the number of procurement actions required from a downsized AMCCOM staff. • The U.S. Government and Army should study the European experience with ordnance privatization, analyze the reasons for the trends, and consider their applicability to the U.S.
Acquisition Policy and Politics	
<ul style="list-style-type: none"> • Acquisition regulations (particularly "Best Value" evaluations, CICA, and SDB "Mentor-Protégé" efforts) will continue to be compatible with industry systems contracting, with the subordination of pure cost evaluations and competition to readiness as the first objective. • Political pressures supporting industry system contracting will increase as declining dollars force downsizing of the sustainable government ammunition base, and the flexibility of "out sourcing" grows in desirability. • Small Business and Small Disadvantaged Business (SB/SDB) goals are reasonable, but they can be met in any of several ways, including through government-directed contracts to SB/SDBs or through flowdown goals and requirements to industry systems contractors. 	<ul style="list-style-type: none"> • The U.S. Army should continue to emphasize MOB base readiness over all other procurement factors, and should make procurement awards based on "Best Value" rather than cost alone. • The Army should consult with industry and trade associations when political influences which are contrary to readiness needs threaten to disrupt the base. The government-industry partnership is critical to maintaining a viable ammunition capability. • The Army should buy ammunition from systems contractors, and rely on them to assist with meeting goals for SB and SDB socioeconomic programs through incentivizing arrangements and creative, proactive "mentor" subcontracting.
Product Management, Requirements, and Improvement	
<ul style="list-style-type: none"> • With industry systems management and competition, the Government and the Army are presented with a broader range of ammunition design concepts. • While the U.S. Army should always be responsible for establishing key milestones, industry systems managers can add flexibility to plan program details and take advantage of industry and government owned facilities to reduce program risk and schedule barriers. 	<ul style="list-style-type: none"> • The U.S. Army should use industry systems management to generate more ideas for ammunition concept development. • The Army should specify milestones, and allow industry systems managers to do the detail planning.

Table 5-1. Conclusions and recommendations (continued)

Conclusions	Recommendations
Product Management, Requirements, and Improvement (Concluded)	
<ul style="list-style-type: none"> • Industry provides greater flexibility to staff programs with appropriate personnel and/or product groups because its personnel staffing practices are not as restricted as Government's. • The U.S. Army is best equipped to partition their overall procurements into meaningful system contracts where well-defined interfaces exist because it normally retains ultimate product/program responsibility. • Industry is highly motivated to develop a TDP that is traceable, producible, reliable, and supportable when their profitability, stability, and success as an industrial systems contractor is dependent on producing, maintaining, and improving TDPs which support smooth transition from development hardware to production hardware. • Government personnel resources to develop and implement system improvements will decrease during the 1990s due to budgetary staffing reductions. Industry can apply investment capital to resolve necessary improvements and thereby protect their market of interest because they consider improvements from a profit standpoint, balancing risk with opportunity. • Industry systems management is more flexible than government systems management, and therefore can reduce schedules significantly by advance releasing funds and using industry facilities to supplement those available in Government. • Industry is highly motivated to pursue investments that complement their business base, reduce program risk through the pursuit of backup options, and promote their general business success. Motivated by profit concerns, industry systems contractors continuously manage risk throughout the product development cycle to reduce potential cost and schedule impacts. • In view of the future ammunition procurement trends, budget and staffing limitations, and advances in technologies being applied to ammunition, using industry for product management would allow government personnel to focus on more strategic ammunition acquisition planning. • The Government can minimize risk by requiring industrial systems managers to offer product warranties based on end item performance and thereby motivate the producer to assure that the technical data package offers the desired level of product performance. 	<ul style="list-style-type: none"> • The Army should select industry systems managers early in the product life cycle to allow their staffing, investment, and facilities planning and implementation to be utilized to improve program success, and to reduce cost, schedule, and technical risks. • The Army should utilize industry systems managers to develop and maintain howitzer ammunition product requirements and to manage the TDP development process. • The Army should continue its present policy of appropriately incentivizing industry systems managers to seek potential beneficial product improvements. • The Army should procure ammunition at the round level and fully delegate schedule performance responsibility to qualified industry system primes. • The Army should incentivize industry to manage cost, schedule, and technical risks by structuring award fees to reward or penalize contractors for system-level program performance.

Table 5-1. Conclusions and recommendations (continued)

Conclusions	Recommendations
Technology Base	
<ul style="list-style-type: none"> • A need exists to strengthen the partnership between Government and industry in the development and application of new ammunition technologies. This will encourage elimination of redundant technology initiatives that are of low priority, and discourage wasteful government versus industry competition relative to technology base development and maintenance. • Industry systems contracting allows the U.S. Army and Government to apply diminishing financial resources towards the retention of irreplaceable technology base assets, such as key government laboratories and test centers. • Industry systems contracting relieves government technical base experts from the overwhelming burden of resolving routine programmatic problems, allowing them to focus on advancing the technology. • Industry systems contracting allows the ongoing globalization of the defense technology base to be directed instead of observed. U.S. industry systems contractors have far more flexibility in working with the offshore technology base than the Government. 	<ul style="list-style-type: none"> • The U.S. Army should encourage the use of joint cooperative IR&D projects between Government and industry. • The Army should improve the partnership aspects of technology management through use of short term technical personnel "trades" and temporary details modeled after the active duty "training with industry" program. • The Army should support the elimination of advance IR&D and B&P "ceilings" applied to contractor rate structures to encourage independently developed incremental upgrades to existing howitzer rounds. • The Army should consider means to make its in-house technical expertise available to be "rented" by contractors through direct subcontracting between industry system contractors and government labs. • The Army and the Government should remove structural barriers to foreign sales by industrial systems contractors. Off-shore sales of howitzer ammunition directly assists in the retention of the U.S. defense technology base. • The Army and the Government should consider a favorable linkage between the evolving contractor certification program and the desire to halt the decline of the onshore defense technology base at the lower tiers.
Mobilization Base	
<ul style="list-style-type: none"> • The active GOCO workloaded base is being cut almost in half. • A significant impact of the DoD budget reduction will be a decrease in the number of suppliers in the industrial base and thereby a decrease in mobilization preparedness. • The Government must become more aware of the economic component of foreign sales and not ignore this contribution to national security based on mobilization base preservation. • The pursuit of foreign commercial sales and defense technology diversification may help the mobilization base survive, and is clearly more achievable using an industry systems management acquisition approach. • Industrial preparedness planning is less detailed than it must be, but Army in-house resources simply are insufficient. • Foreign dependency is growing, and irreversible, but constitutes less of a crisis than in the past. 	<ul style="list-style-type: none"> • Sharing IPP responsibilities with industry system prime contractors would utilize the strengths of both parties if contractors are evaluated, and positively and negatively incentivized to perform meaningful system-level planning. • The U.S. Army should establish world-wide materials data bases, and then monitor industry company-to-company cross-border sourcing agreements, at the system level. The Army should also require U.S. industry system primes to identify foreign content and to provide supply interruption risk reduction plans. • The Army should commit to industry systems contracting, on the condition that LAP work be accomplished in GOCO plants via third party contracts. • The Government should workload only those plants which perform government-unique work (HMX, RDX, propellants, Navy bombs, etc.).

Table 5-1. Conclusions and recommendations (continued)

Conclusions	Recommendations
Role of Foreign Sales	
<ul style="list-style-type: none"> • With government assistance, industry is structured to include marketing staff which can proactively pursue foreign business opportunities to help maintain a warm production base. • The Government must consider policy changes to help U.S. industry pursue foreign sales opportunities which do not jeopardize the U.S. security, and thereby help preserve U.S. readiness posture. 	<ul style="list-style-type: none"> • The U.S. Army and the Government should procure FMS ammunition rounds on an industry systems contracting basis, at the same level as they are requested in the Letter Of Agreement (LOA). • If an industrial firm has expended significant cost and effort to secure an FMS order on behalf of the Government, the Army should support industry's role as systems management focal point with the foreign customer. • The Army and the Government should revise the breakout pricing model currently used to price FMS estimates to include all costs, as defined in the Unit Cost Resourcing (UCR) guide issued by the OSD comptroller. • The Army and the Government should revise FMS cost allowability practices immediately to accept FMS G&A rates in all FMS negotiations.
Total Cost	
<ul style="list-style-type: none"> • Competition motivates industry to minimize product price and use aggressive risk management procedures to control total system cost. • Industry is motivated and incentivized to introduce product value engineering change proposals during production which will reduce unit product cost. • Assemblies and systems procured from industry systems contractors have significantly steeper experience/learning curves than piece parts procured from component contractors under breakout—thereby reducing unit product cost over the total quantities produced (contributors include VECs and competition). • Learning curve improvement is a result of investment driven by program revenue: piece part procurements have flat learning curves and low revenues, assembly and system procurements have steeper learning curves and higher revenues. • Learning curve differentials of 5 to 15 percent between industry systems management and government systems management procurements are caused by two other factors: <ol style="list-style-type: none"> 1. Lack of production gaps due to bridge funding (approximately 5 percent of differential). 2. Strong cost reduction and VEC performance (approximately 3 percent of differential). 	<ul style="list-style-type: none"> • The U.S. Army should procure ammunition using industry systems contracts to allow and facilitate industry to do what industry does best: value engineer the product, support small subcontractors with engineering expertise, manage production with bridge funding if necessary to avoid production gaps, control costs by bringing cost driver components in house to manage and control, and fix product problems via industry's shorter command and control loop. • The Army should use competitive multiyear procurements to increase the system contractor's incentive to invest and reduce costs through learning curve improvements. • The Army should encourage and facilitate VEC activities. • The Army should institute fully loaded costing systems for government systems management, to ensure high quality management decisions based on full disclosure of total costs. • The Army should begin to record learning curve data to expand the knowledge base for future decision-making. • The Army should convert award selection criteria from "instant contract bid" to "best value" and "full life cycle cost" in support of current government objectives, and shift from "cost only" to readiness and quality as paramount procurement drivers.

Table 5-1. Conclusions and recommendations (continued)

Conclusions	Recommendations
Total Cost (Concluded)	
<ul style="list-style-type: none"> • Adjusting for the government's hidden costs, top rates (G&A and S&T) for industry and government are about the same since similar functions exist in both industry and government. • Single-source industry systems primes can achieve improvements rates as steep as competitive awards if the industry systems prime has a strong cost reduction/VECP culture and is encouraged to do so by the Government. • Fixed priced production contracts represent lower risk to the Government in industry systems management acquisitions than in the government systems management acquisitions. The cost for this risk reduction is industry systems manager's profit. 	
Investment	
<ul style="list-style-type: none"> • Breakout contracting increases industry risk of losing program positions, and thus tends to destabilize programs and reduce incentives for investment. • Systems contractors will invest in ammunition R&D facilities and people, as long as they continue to believe that the expected payoff will significantly exceed the level of investment. • Given an opportunity and a potential payoff, industry systems contractors will invest heavily in the programs which they are selected to manage throughout all phases of the program life cycle. Although the Government allows recovery of a good portion of these investments, industry system contractors do invest a large portion of their profits in the programs they manage. • With respect to readiness, industry systems management offers an advantage over government systems management (breakout) across all phases of the life cycle. The timeliness of winning systems management programs is clearly tied to the timeliness of various investment phases for that program. • With respect to product quality and the trend toward certification, industry will make the necessary investments to be certified if they wish to continue to be defense contractors. The key to success will be to enable industry to manage programs with a reasonable expectation of control and of payoff for their work and investments. 	<ul style="list-style-type: none"> • The U.S. Army should adopt industry systems management contracting as the preferred acquisition approach, thereby encouraging continued investment in ammunition R&D and production by system primes. • The Army should encourage defense industrial investments for howitzer ammunition by utilizing those contractors whose long range business strategies include the development and production of ammunition products as a core business. • The Army should decide early in the life cycle of a product the extent of anticipated industry involvement, since industry will invest only where a reasonable payoff can be expected. • The Army should evaluate existing government and defense industry capabilities and facilities for redundancy and/or synergy, and let contracts which enable industry system contractors to use or improve government facilities wherever possible, to minimize unnecessary investments. • The Army should adopt contractor certification as a major instrument of identifying and selecting qualified contractors who will invest in ammunition as a core business.

Table 5-1. Conclusions and recommendations (concluded)

Conclusions	Recommendations
Schedule	
<ul style="list-style-type: none"> • Industry systems management offers the best likelihood of success in meeting stringent schedules for both ammunition development and production. When motivated as a systems contractor, industry has repeatedly demonstrated the capability and flexibility to respond to development cycle requirements on both tech transfer and new development rounds. • Judicious sharing of resources within the Government and industry enable the government/industry systems management team to meet schedule. The industry systems manager can more easily bring on line special development laboratories and test ranges specifically dedicated to the program. Industry also has the advantage of flexibility in hiring practices, capital spending, advance releasing, etc., to meet the stringent schedule requirements. 	<ul style="list-style-type: none"> • The U.S. Army should utilize industry systems management for howitzer ammunition acquisition to the maximum extent possible. Government systems management should be used on an exception basis only, on programs with substantial history of proven timely production. • The Army should make major programmatic decisions as early as possible, regardless of whether industry or government systems management will be used for a new program. This will save valuable lead time for the government, and will stimulate prospective industry managers to make investments which support the program.
Total Quality Management	
<ul style="list-style-type: none"> • Industry systems management offers the U.S. Army a single point of responsibility and accountability for quality management (i.e., integration/LAP, LAT, and performance/warranty). The industry systems contractor is more motivated to increase quality and reduce costs, by improving both the product and the schedule, since there are more financial incentives to do so. • Industry systems managers can be motivated to assure customer satisfaction by warranties based on product performance. • Improved product development practices, such as concurrent engineering, can shorten product development schedules and enhance product quality. • Industry is considered capable of more easily implementing concurrent engineering practices during product systems development than the Government. • Industry systems managers have profit and competitive motives to reduce costs through continuous improvements of business processes. • Contractor certification can help promote TQM principles for industry systems managers. Certification offers cost savings to the U.S. Army in the form of reduced government oversight costs. 	<ul style="list-style-type: none"> • The U.S. Army should procure ammunition at the "round" level, and hold the systems contractor 100 percent accountable for all aspects of quality performance under contract and after product delivery (using warranties). • The Army should include provisions for concurrent engineering on all future ammunition development contracts. • The Army should utilize contractor certification programs to increase quality and to reduce micro-management of ammunition procurements. • The Army should utilize warranties at the ammunition round or system level to encourage contractor quality performance.

These advantages to the Government are summarized in Figure 5-1, using the attribute-product life cycle scoring approach presented earlier in Section 3. As shown in the matrix, Readiness benefits peak in Production and Post-Production; Cost benefits ramp up through Pre-Development and Development and peak in Production; Quality benefits start early in Pre-Development and hold their own through Development and Production.

The summary level benefits of industry systems management are further quantified in Figure 5-2, which scores the benefits for all of the key acquisition drivers over the product life cycle. In summary, industry systems management offers the Government the following benefits:

Pre-Development

- Industry investment in R&D for new ammunition concepts enhances competitive position, thereby maintaining and expanding the U.S. defense technology base
- Industry system prime's ability to provide political lobby to support government defense acquisition objectives, from Pre-Development, through Development and into Production.

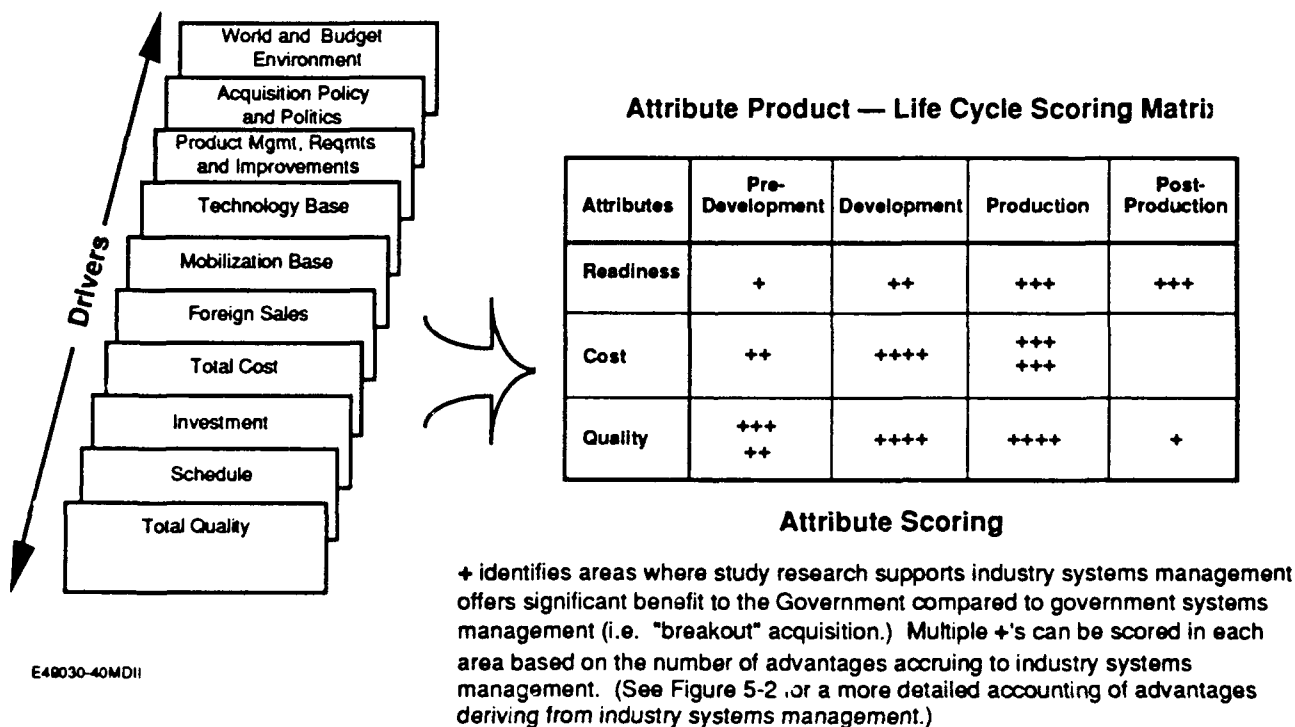


Figure 5-1. Summary level benefits of using industry systems management over the product life cycle

		Drivers									
		World and Budget Environment		Acquisition Policy and Politics		Product Management Requirements and Improvements		Technology Base		Mobilization Base	
		Foreign Sales		Total Cost		Investment		Schedule		Total Quality Management	
Pre-Development	Readiness				+						
	Cost				+				+		
	Quality		+	+	+				+		+
Development	Readiness			+	+						
	Cost			+				+	+	+	
	Quality		+	+	+						+
Production	Readiness					+	+			+	
	Cost	+		+			+	+	+	+	
	Quality		+	+	+						+
Post-Production	Readiness					+	+				+
	Cost										
	Quality			+							

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+ Identifies areas the Government will receive significant benefits by using industry for product system management.

Figure 5-2. Advantages and benefits of using an industry systems manager approach to howitzer ammunition procurement, development, and production

Development

- System-level competition among qualified industrial sources for the industry system management job
- Industry motivation to develop a complete technical data package that can easily be transitioned into production by the industry systems manager
- Follow-on production incentive to aggressive management of interface control and technology integration for increasingly more complex ammunition rounds

Production

- Industry profit-driven incentive to reduce scrap and maintain process margin, thereby providing quality and cost competitiveness at the system level
- Industry profit-driven incentive to value engineer products and reduce cost during production
- Industry profit-driven incentive to solve problems at the system level that arise in production and maintain scheduled deliveries
- Industry motivation to deliver reliable product, using systems performance warranty incentives
- Industry motivation to introduce product performance improvements during production, thereby extending product life and reducing the frequency and need for new start competition

Post-Production

- Industry problem-solving capability to pursue corrective actions as needed to avoid warranty claims
- Industry capability to market ammunition for foreign sales, thereby maintaining a warm production base that enhances U.S. mobilization readiness

5.3 Criteria for Use of Systems Contracting

The HASP contract Statement of Work (Section C.2(b)) included a requirement to identify criteria for the use of systems contracting. This decision whether to use government systems management or industry systems contracting—will continue to require case-by-case judgement of government acquisition managers. The considerations, shown in Table 5-2, are offered as a guide to facilitate the decision-making process. The issues and factors shown in the table more directly apply to ammunition than do the “component breakout” considerations listed in DFAR 217.7202-3. The final decision should be approached by considering and weighing all factors interdependently.

Table 5-2. Ammunition systems contracting decision aid

Issues	Compatible with Government Systems Management	Industry Systems Contracting Preferred
Technical Factors System complexity Degree of change from prior configuration Frequency of ECP and VECP activity Criticality of precision targeting Status of collateral/parallel developments	Unitary HE round Minimal change from prior TDP No changes for two years Area targets Little or no interface with higher level systems	Submunition or electronic-based Significant differences from prior TDP High frequency of ECP/VECP Point target accuracy Extensive interdependence with gun tube, fire control, logistics support
Cost Factors Government content (explosives, propellant, LAP) as a percentage of round cost Criticality of cost/cost control	Government cost content high Need to minimize variable cost	Government cost content less than half Need to control total costs
Management/Other Factors New or follow-on production Subsystem sources established Schedule urgency Availability of government staff Geographic co-location of government management team Component lead times Foreign involvement/content Foreign sales potential Importance of readiness Outside interest/oversight	First and second year deliveries completed successfully High quality multiple subsystem sources established Low Ample resources All disciplines on-site at local command Short lead times (three months or less) All domestic (includes Canada) No interest Inventory backfill Little visibility outside AMC	Newer or transitioning to production Limited or new vendor base, or with TQM relationships High perceived priority/urgency Headcount limitations Key function out of local area Long lead times Foreign participation Good potential market Direct troop support (training included) High visibility

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APPENDIX A IMPLEMENTATION CONSIDERATIONS

The intent of this appendix is to complement the conclusions, recommendations, and selection offered in Section 5. The section focuses on changes, within the authority of AMC, which would remove some of the roadblocks to industry systems contracting for 155mm Howitzer Ammunition. The policy and practice changes to be discussed include:

- Small Business/Small Disadvantaged Business (SB/SDB) goals
- FMS price quotations using new accounting standards
- GOCO management for readiness
- GOCO costing
- Guidance regarding OMB policy number A-76 and DOD FAR Supplement 217.7202-3.

Based on the international market trends discussed in Section 4 of this report, it appears that a good pilot program taking advantage of the above recommended policy and practice changes would involve international business opportunities (FMS and/or commercial) for 155mm ammunition where there is not a significant level of competition. Implementing the following changes, using FMS or commercial sales, would have several positive effects:

- Serve as a pilot for future howitzer ammunition procurements
- Protect a portion of the howitzer ammunition mobilization base
- Avoid facility layaway costs, if applicable.

Small Business/Small Disadvantaged Business (SB/SDB) Goals

Currently, AMCCOM cannot take credit for small business subcontracts let by industry in the same manner as prime contracts between Government and SB/SDBs. Because of the way the SB/SDB goals are structured, they represent a roadblock to industry systems contracting for howitzer ammunition that is currently being procured under government systems management acquisitions (i.e., breakout). However, discussions with upper Army management suggests that there is a willingness to adjust or change these goals, provided changes are not perceived as a means to circumvent the goals. It must be clearly understood that the conversion from government systems management to industry systems contracting will not reduce total opportunities for Small and Small Disadvantaged Businesses.

We recommend that AMCCOM adjust these SB/SDB goals to accommodate industry systems contracting for the following reasons:

First, the amount of SB/SDB business in the howitzer ammunition base is relatively small in comparison to the total goal. Therefore, shifting to industry systems contracting would have a very small impact on the total goal as it is currently formulated.

Second, the intent of the goals (i.e., assuring an equitable amount of government contracting with SB/SDBs) can be met via industry systems contracting. AMCCOM can still meet its SB/SDB goals by

exercising its current authority regarding submission and approval of Make/Buy Plans and SB/SDB Subcontract Plans by the potential systems primes.

Third, the Mentor-Protege Program, established under Public Law 101-510, the DOD Authorization Act of 1991, encourages system primes to enhance SDB capabilities to compete and perform on defense contracts. The Mentor-Protege Program is intended to enhance SDB's role in the MOB base by incentivizing system prime contractors to help the SDBs to compete. Satisfying the law will reduce the number of government-direct prime contracts with SDBs, but will potentially increase the total SDB share of AMCCOM's contract dollars. This program is also an indication of a shift in congressional focus from prime contracting SDBs to subcontracting with SDBs through industry primes.

AMCCOM can control the small business mix in the howitzer ammunition base by calling for, and requiring approval, of Make/Buy Plans and SB/SDB Subcontract Plans in the submission of proposals from potential systems primes. Protection of the current mobilization base could be explicitly factored into the review and approval of the plans.

Resolving the issue of Small Business/Small Disadvantaged Business contracting does not require regulation change. The recommendation discussed above could be accomplished by AMCCOM within the context of current government policies and practices, and exercised as a part of an RFP for systems prime contracting on FMS cases for 155mm Howitzer-delivered ammunition.

FMS Price Quotations Using New Cost Accounting Standards

The new government accounting system requires all costs associated with a particular product to be charged to the procurement line item. We recommend that AMCCOM's current implementation plan for integrating the new government accounting system include a pilot program for 155mm Howitzer and/or perhaps other ammunition FMS cases. This pilot program would serve three primary purposes:

- First, by quoting FMS cases to include those overhead costs (i.e., headquarters systems management costs) which have traditionally been part of OMA budgets, AMCCOM would bring the government systems procurement price quotes more in line with industry systems procurement price quotes. This would provide AMCCOM with more discretion in exercising industry systems contracting options.

- Second, if OMA type costs are not quoted on FMS cases which will actually be produced after the new accounting standards are fully implemented, there is a potential for a significant cost overrun on those FMS cases which would be managed as government systems management opportunities. However, if those FMS cases are quoted with the new accounting standards, then accruals would be correct two years from now regardless of whether the program is executed as a government systems procurement or as an industry systems procurement.

- Third, a few FMS cases using the new accounting standards could serve as an excellent pilot program for AMCCOM, while AMCCOM arranges for their other U.S. procurements to be executed in the same way.

Again, the above recommended change can be implemented without policy change by simply modifying the implementation plan currently in place at AMCCOM to accommodate the new accounting system.

GOCO Management Relationships for Readiness

Given that a minimum GOCO base is essential to assure future ammunition readiness, while cost competitive pressures are forcing industry to consider commercial LAP and propellant sources, AMCCOM should consider altering its approach to GOCO readiness management and product costing.

First, we recommend that AMMCOM convert all current general purpose LAP plants from GOCO-type contracting arrangements to basic facilities contracting arrangements. This would put them on similar (not identical) footing as other LAP facilities.

Second, we recommend that AMCCOM shift readiness planning from a focus on plant planning to concentration on ammunition round planning. For example, instead of executing multiple DD Forms 1519 with component parts suppliers for each round of ammunition, AMCCOM could maintain a single readiness plan and Form 1519 for a total round with an industry systems contractor. AMCCOM could then assign the responsibility for the readiness planning of the subsystems to that prime, along with the applicable GOCO-based facilities, the GOCO operator team, and the other MOB base suppliers. AMCCOM could then use the limited IR resources to do spot checks and CRIB surveys to measure how well and with what validity the planning and readiness work is being done. If the systems contractor does the job well, he can earn additional award fee. If he receives two consecutive "unsatisfactory" ratings, he can be terminated as the prime contractor for that round. A prime contractor could even be required to produce a small quantity every 24 to 36 months to demonstrate the validity of the plan, which might combine limited materials stockpiles with facilities to minimize lead time for a vital item which is not in active production.

Third, we recommend that AMCCOM make GOCO plant facilities not currently tied to a specific round available to all base members on a noninterference basis. This is the current, effective practice at Twin Cities AAP, where the basic facility operator, Federal Cartridge Corporation, maintains the grounds but no longer runs any factories.

If all general LAP GOCO plants are put on this same status (nonworkloaded, but with specific production lines assigned to certain rounds), the plants will essentially be "open" insofar as actual production is concerned (i.e., when they are the facilitated source for an item which has active requirements). This way AMCCOM could be relieved from the political pressure about closing or not closing a specific plant. The GOCO workload would then be a function of Army requirements for the assigned rounds and GOCO operator success in securing a supplemental workload. The identification of plants with particular rounds could be done competitively initially, through IR directed planning, or through system prime selection from among a GOCO plant bidder list furnished by the Government. The key is that IR and industry would work in true partnership, with positive and negative incentives, to ensure readiness.

GOCO Costing

Current methods of accruing costs at the GOCOs for AMCCOM-directed work versus third-party work create two roadblocks to industry systems contracting:

- First, in gauging "best value" to the Government, AMCCOM does not currently utilize cost accrual methods which reflect government GOCO management fees and overhead costs. AMCCOM work contracted to GOCOs shows no profit, even though there is a management fee for managing the entire facility. Also, AMCCOM's overhead rate structure is not fully absorbed by the contracted cost. This situation distorts the "best value" evaluation of industry systems contracting (versus government systems contracting).

- Second, in the case of international FMS versus commercial sales, these same distortions in cost accrual and rate structure provide an unfair competitive advantage to government-directed FMS bids over commercial bids by industry systems prime. This unfair advantage is created by the rate differential between the workloaded GOCO estimate and the third-party bid.

We recommend that AMCCOM consider either a single rate structure for cost accrual at the GOCOs or make adjustments to the evaluated numbers when comparing government systems contracting versus industry systems contracting. This will facilitate fair and equitable "best value" evaluations on future procurements.

In FMS cases where countries are evaluating the difference between FMS and commercial procurement of the product, AMCCOM can find itself in competition with the industry systems primes' commercial quotes due to the different rate structures that the GOCOs must use. In the case of FMS quotes, we recommend that AMCCOM consider a policy of using third party rates to bid FMS cases even if the work is to be accomplished in a government-directed procurement. Without this change, there exists the potential for continued subsidizing of international buys through the FMS program.

The impact of this policy change on 155mm Howitzer-delivered ammunition should be coordinated with USAAC. Additionally it should be changed consistent with the accounting standards change discussed previously.

Guidance Regarding OMB Policy A-76 and DFAR Supplement 217-7202-3

OMB policy A-76, and the Defense Industrial Production Act of 1973, which address the U.S. Government's acquisition policy, stress production economies and productivity enhancements through competition and through reliance on the commercial sector. On the other hand, DFAR 217-7202-3 stresses the desirability of breakout procurements which the government program manager manages and administers. Viewed together, OMB A-76 and DFAR 217.7204-3 are in apparent conflict.

We recommend that AMC review what appears to be conflicting policy in OMB policy A-76 and DFAR Supplement 217-7202-3. Guidance in the form of a policy letter should be issued to clarify any potential misunderstanding and provide the procurement organization with the latitude to exercise the "best value" procurement option. This change may still result in transitioning from sole source acquisitions to breakout acquisitions, or in competition at the systems prime level, or, where readiness is paramount, in directed procurement with the appropriate rationale.

We recommend that AMCCOM draft a policy letter placing each of these guidances in context with the effort to make "best value" procurement decisions the baseline practice for the U.S. Government. This policy letter's explicit purpose should be to sort out the apparent discrepancies in these two policies.

In Summary

It appears there are several implementation options available to AMC which could provide the procuring officer with more latitude in making the government systems contracting versus industry systems contracting decision. The implementation recommendations discussed above would still satisfy the need for competitive "best value" decisions by the U.S. Government where planned mobilization producers are not involved.

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APPENDIX B HOWITZER AMMUNITION SURVEY

The objectives of the HASP companion survey were to test and to verify the study conclusions, if possible, and also to "take the temperature" of the Ammunition base regarding the HASP statement of work issues such as cost, schedule, and quality.

A primary concern of Alliant Techsystems and the Government was to ensure that the survey results were not driven by its methodology and conduct. Such an undertaking is worthless if either its results are invalid, or are perceived to be invalid. This was the reason for the retention of the outside survey specialists, Questar Data Systems. Their clients include, among others, Bank of America and Honeywell Inc., for whom they conduct annual Employee Attitude Surveys. The American Defense Preparedness Association (ADPA) Industry Affairs Division was also invited and consented to co-sponsor the poll. This allowed a means of coordinating the survey without the day-to-day supervision of Alliant Techsystems.

The final original questionnaire responses will be forwarded to ADPA by Questar to ensure integrity of the proprietary positions of potential competitor firms. Alliant Techsystems will never be permitted to review identified responses of any industry respondent. Alliant Techsystems will receive retyped anonymous summaries of comments, plus the data reports included in this appendix. Summary copies of the written comments will be forwarded to ADPA for their files and to the Government. ADPA will also furnish copies of the survey summary to its members upon request.

As was noted in Section 3, Methodology, Alliant Techsystems participated with Questar in the identification of question subject matter, but not in the preparation of the questions themselves. Questar was asked to write the questions in ways which would not lead to preferred responses. The questionnaires were furnished to ADPA and AMCCOM for review prior to release, and the mailing lists were the result of extensive AMCCOM input to ensure the most valid cross-section possible. Special effort was extended to ensure adequate opportunity for responding, so that the results would provide the best possible compendium of the collective sense of the ammunition community at this point in time. A list of solicited enterprises is included at the end of this appendix. All have some type of role in ammunition (non-missile) production.

The most surprising results included the virtual unanimity of disregard for the prevailing practice of awarding all production contracts on the basis of lowest instant contract offer, and in favor of some type of "Best Value" criteria, heavily weighted toward quality. There were only a small minority of Small Businesses who opined that lowest contract bid is an appropriate acquisition technique. What was surprising was the widespread skepticism among Government and Industry alike that the Government will ever actually change its award practices. This view was expressed in half of the written comments to that question.

Unsurprising comments were found in the areas of the effect of breakout on foreign ammunition sales. There was strong agreement that industry can contribute significantly to foreign sales through marketing. Sample Government responses are quoted here to show the flavor to the prevailing opinions; the industry view was even stronger frustration with the negative impact of breakout production on foreign sales:

- "Breakout kills overseas sales. It creates a situation where no company can put an attractive package together."

- "The more we break out a system, the less a systems contractor can control his ability to market in good faith. In fact, he cannot realistically market at all."
- "Government maintains artificially low prices (for FMS). Government should be fully burdened just as commercial sales price to ensure apples to apples comparison."

Other areas of broad agreement in the written comments were a strong endorsement by all groups of GOCO Third Party contracting and a general disregard for the practice of supplying Government Furnished Material (GFM) on both total cost and quality grounds.

There are several areas where interpretations of the data provided in the Questar Report should be supplemented with additional points. The issues, along with the location in the Questar summary, are provided below.

- 1) P.4, Foreign Sales Base. The numbers were expected to be as small as they are in terms of companies' current foreign sales bases. We believe that this is due to the fact that many exports were not encouraged in the past, and also because of widespread breakout and cost allowability practices which have discouraged industry marketing abroad.
- 2) P.6&7, GFM. It should be noted that the reduced experience of GFM problems encountered by Small Businesses is likely related to a reduced incidence of receipt of GFM. The GOCO plants heavily favor prime-furnished and plant-procured material.
- 3) P.6, Problematic TDPs. Though there is an industry history of contractors resolving many TDP problems themselves, it is likely that future dollar pressures will cause industry to increase its tendency to file claims against the Government for TDP defects.
- 4) P.7, Industry Incentives. While the third bullet shows that industry has allowed its profits to be impacted in the past by exceeding IR&D and B&P ceilings, it is likely that this practice will come under increasing stockholder financial pressures—unless the current Congressional initiative to allow full reimbursability for IR&D and B&P is successful.
- 5) P.8, Warranties. There are differing views of the cost-effectiveness of system-level warranties, including within a single company. In the competitive environment, the warranty costs are frequently squeezed out of the bid price during the Best and Final Offer (BAFO) stage. However, the mere presence of a warranty clause forces industry to manage programs differently to minimize cost risk, legal exposure, and damage to reputation. Therefore, as the survey notes, large businesses frequently do "warranty" work voluntarily to avoid the clause, and they also tighten quality standards. This is a perfect example of how TQM implementation in the real world is a desirable and cost-effective practice. Industry would prefer to avoid all risk exposure of warranties, but the Government should ask, before devaluing system-level warranties, what industry practices would change if warranty provisions did not exist.

Following this page is the Questar survey report.

APPENDIX B

HOWITZER AMMUNITION SYSTEMS PROCUREMENT SURVEY

ANALYSIS AND SUMMARY OF RESULTS

JUNE 1991

Questar Data Systems, Inc.
2905 West Service Road
Eagan, Minnesota 55121

HOWITZER AMMUNITION SYSTEMS PROCUREMENT SURVEY

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Howitzer Ammunition Systems Procurement Survey

Summary of Findings

INTRODUCTION

This survey was developed and conducted by Questar Data Systems, Inc. (QDS) in conjunction with the American Defense Preparedness Association (ADPA) and under contract to Alliant Techsystems, Inc.

Survey Objective

The survey was commissioned as a part of a larger study focused on system management, especially as it relates to howitzer ammunition. The primary objective of the survey is to gain a better understanding of the current world trends in system management. As a result, survey participants were to be selected based on their ability to provide critical insight into the issues surrounding system management. There are also some secondary objectives of the survey:

- ☐ Allowing for direct input from senior management within Government and Industry.
- ☐ Signaling issues that may be barriers to ammunition systems management.

Survey Methodology

The Alliant Techsystems study team developed a list of issues, dimensions and drivers to implementing ammunition systems management. The team asked Questar Data Systems to develop a survey questionnaire around this issue set. Four major issues were identified by the study team:

- ☐ Total quality management (TQM)
- ☐ Total system cost and schedule
- ☐ Howitzer ammunition base readiness
- ☐ Product life cycle relationship

These issues were translated into 50 questions, about two-thirds being scaled and one-third open-ended in nature. This mix of question types allowed for both a quantitative and qualitative data set to draw upon. The ADPA was asked to sponsor the survey, and their feedback was sought in modifying the questionnaire and survey process.

When formulating the survey questions, it became clear that specific questions were aimed at four audiences:

- ☐ Government
- ☐ Industry
- ☐ Industry-managed GOCO's
- ☐ Small businesses

While the majority of questions would apply to all four groups, some questions would not be applicable to the Government or small business participants. Three versions of the survey were developed to handle the uniqueness of the audience. A government version would be sent to senior Government managers, and a small business version would be sent to SBD's as well as small business leaders. An industry version of the survey would have a special section of questions at the end for GOCO's. In addition, the survey was pre-tested with a small group. Revisions and modifications to the survey content were made based on the results of the pre-test.

To emphasize the importance of completing the survey, the ADPA sent a personalized letter to each participant announcing the purpose and distribution of the up-coming survey (Appendix A). Approximately one week later, each participant received a survey packet from the ADPA (Appendix B), which contained:

- ☐ A personalized cover letter from the ADPA re-stating the purpose of the survey.
- ☐ An appropriate version of the survey.
- ☐ A self-address, postage-paid reply envelope.

The surveys were distributed in early April, with reminder phone calls made in early May to encourage non-participants to complete the survey. The distribution was completed in early June.

Survey Participation

A total of 75 participants were identified to receive the survey. 30 participants were identified from the Government group and 45 participants from the Industry group. The Industry group included:

- ☐ 8 GOCO's
- ☐ 19 small businesses and SBD's

31 surveys were returned for a response rate of 41%. The small business group had the lowest response rate at 32%, while Industry and Government returns were 48% and 40%, respectively. Considering the sensitivity of the information asked in the survey and the elite audience who received it, a response rate of 40% should be considered as average. While the results are valid, this sample size somewhat lowers the ability to generalize the results across all Industry and Government senior management identified to receive the survey. Given the number of responses, the results (for scaled questions) can be generalized to 85% of Industry and Government senior managers, with a margin of error of 5 points. This is close to the level of statistical reliability commonly used in public opinion polls.

There is no statistical method to measure the reliability of qualitative results, however. Respondent's comments need to be treated as unique insights. Although many comments may contain similar answers, these can not be reliably generalized to the group at large.

PROFILE OF RESPONDENTS

The analysis of demographic questions provides the following profile of the HASP survey respondents.

Company Type

- Compared to small businesses (SB's), more large firms provide "full service" system management.

Nearly two-thirds of the large companies, and only a third of the SB's have the resources to provide a full range of capabilities for ammunition or missile systems production. A similar percent of both groups (about 15%) maintain their own R&D technology base. SB's are much more likely than large firms to be exclusively build-to-print organizations. Half of the small businesses say they are build-to-print firms versus 23% of the large companies.

Sales Base – Government vs. Industry System Contracts

- Large businesses tend to derive a higher portion of their sales base from Government system managed contracts than do small businesses.
- Compared to SB's, large firms derive a higher percent of their sales base from system contracting with Industry as well.

Most large businesses (39%) derive 31-60% of their sales base from Government system managed contracts. The same is true of small businesses, although another 40% of SB's report that less than 30% of their sales base is generated from Government system managed contracts. Unlike SB's, 30% of large firms derive over 80% of their sales base from these break-out contracts, while none of the SB's have sales at this level.

Large businesses also report generating a higher percent of their sales base from system contracting with Industry. While small businesses report having a higher portion of their sales base from contracting with Industry, over half of the SB's derive less than 30% of their sales base from these contracts. This is in sharp contrast with large businesses, where well over two-thirds report 31% to over 80% of their sales base generated from contracting with Industry.

Foreign Sales Base

- More large firms derive their foreign sales base from direct "commercial sales" than do small businesses.
- More large firms derive their foreign sales base from FMS case marketed by their organizations than do small businesses.

Half of the SB's reported that none of their foreign sales base comes from direct commercial sales -- this is true for only 21% of the large businesses. While both large and small firms only generate 1-20% of their foreign sales base from this type of sale, there *is* a notable difference between the two groups. More large businesses (71%) than SB's (50%) derive 1-20% of their foreign sales base from direct commercial sales.

Again, the trend for large and small businesses alike is to have only 1-20% of their foreign sales base FMS case marketed by their firms. Three-fourths of all SB's and nearly 40% of large firms have none of their foreign sales base generated by this method. Large businesses are clearly more active in this market, since 62% report deriving their sales base from FMS case marketed by their firms -- compared to a quarter of SB's.

When it comes to the Government's role in promoting foreign sales, a majority of large and small businesses agree that the Government needs to do more than just protect US interests. This is especially true of the large businesses, while a third of the SB's said the Government should not do more than protect US interests in foreign sales.

Portion of Business from Contracting

- The majority of large and small businesses alike act most often as a sub-contractor. About a third of both groups act as a prime contractor.

Moreover, the majority of SB's (67%) and GOCO's (83%) prefer to have third-party contracting done with an Industry system prime contractor, rather than with Government workloading. In addition, the majority (89%) of Government respondents said third-party contracting is more effective overall in regard to cost, technology and schedule than Government workloading of GOCO's. (GOCO's also report their production processes (e.g., scheduling, function of parts and configuration fitment) run more smoothly with plant procured materials, rather than with prime furnished materials or those supplied by GFM.)

Test Facilities

- About a third of large firms maintain their own full round test facilities, while do none of the SB's.
- The majority (over two-thirds) of both groups would use Government test facilities if readily available and economical to use.

SYSTEM MANAGEMENT DATA TRENDS

The following section summarizes the results found throughout the HASP survey. In order to better capture data response trends (i.e., patterns in the data), the questions have been grouped into six topics:

- ☐ Government vs. Industry Control
- ☐ Quality & TQM
- ☐ Industry Incentives
- ☐ Level of System for an Ammunition Round
- ☐ Learning Curves
- ☐ Warranties

Government vs. Industry Control

- All three groups (Government, large and small businesses) agree that somewhat more Government than Industry control better ensures readiness for field use and true competition
- There is also agreement that more Industry than Government control better ensures innovation, continuous improvement and timely delivery of end items.
- The respondents agree that issues of schedule management and timely/efficient contracting are best controlled by a blend of both Industry and Government.
- All three groups strongly agree that more Industry than Government control of the production process is optimal, while the design/development process requires a mix of Industry and Government control.

Overall, the most disagreement between the three respondent groups is seen when looking at maximum accountability for cost management, technical success and failure.* Large and small businesses feel that Industry control has more accountability for *cost management*. Yet, Government respondents see cost management accountability as a mix of both Industry and Government control. A fairly wide range of opinions also exists for accountability in *technical success*. Government and large business see Industry control having maximum accountability for this, while SB's see accountability for technical success being a blend of Industry and Government control. SB's also view technical failure as being a mix of Industry and Government control. Large business and the Government respondents look more toward Industry control for *technical failure* accountability.

The three groups of respondents also disagree as to which system management approach facilitates lowest total cost. Large and small businesses see that more Industry control rather than Government control is conducive to lowest total cost. However, the Government respondents feel that control should be shared between Industry and Government to bring about the lowest total cost.

**Note In some oral administrations of the survey, it was noted that respondents misinterpreted the intent of these questions. The intended meaning was to view maximum accountability from an ideal state. Respondents' answers may be capturing their perceptions of how maximum accountability is currently handled. This may in part explain the wide variation in agreement with these questions.*

Quality & TQM

- All three groups agree that quality is the most important and the most appropriate best value criteria to be used in DoD system evaluations.
- There is also strong agreement that Industry system contracting, not Government system management, is more compatible with TQM implementation.
- Compared to the other respondent groups, large firms are more critical of the quality and producibility of TDP's. However, while the majority of the Government respondents are satisfied with the quality of TDP's, a large percent are dissatisfied with the producibility of TDP's.
- Compared to large businesses, SB's report substantially fewer problems with GFM on schedule and function/fit issues, but are more likely to file a claim when GFM-caused problems arise.

The most agreement between the three respondent groups is seen in the best value criteria. 90% of large business, 80% of SB's and 70% of the Government respondents selected quality as the most appropriate best value criteria to be used by DoD. (Small business selected both quality and contract cost as the top best value criteria.) Life cycle costs, and mobilization and readiness were selected by large business and Government respondents as other important criteria. Compared to large business, small business and Government tend to give more importance to contract costs.

There is also very strong agreement around the issue of price-only competition providing the best value to the Government. 100% of the large business and Government respondents feel that price-only competition does not provide best value. A majority (87%) of SB's also agree.

There is some disagreement around whether Government or Industry better promotes TQM with their suppliers. While half of the Government respondents and two-thirds of SB's feel that Government largely promotes TQM with its suppliers, 43% of large business agrees. Conversely, all large business and two-thirds of SB respondents feel that Industry largely promotes TQM with its suppliers - only 38% of Government respondents agree. However, the majority of all three respondent groups report that Industry system contracting, rather than Government system management, is the most compatible with TQM implementation.

Compared to the other groups, large business sees of a need for certification requirements for potential contractors in order to be eligible for an award. While 62% of large business agrees with the certification requirement, half of SB's and Government respondents feel no need for this requirement.

Large and small businesses tend to use a variety of strategies to deal with problematic TDP's. However, neither group reports ever filing a financial claim against the Government even though large firms express a high level of dissatisfaction with TPD quality and producibility.. About a third of both groups will correct the TDP as a part of the program. SB's tend to notify the Government and request technical assistance more often than do large business. And large business will use other, internal procedures to deal with problematic TDP's more often than will small business.

Even though large businesses more frequently encounter problems with GFM on scheduling and function/fit, SB's are more likely to file claims when GFM causes difficulty in the production process. Three-fourths of SB's and 58% of large business report filing claims when GFM causes problems. Yet, about a third of large businesses report a high incidence of GFM-related schedule and function/fit problems while only 17% of SB's encounter the same frequency of problems.

Industry Incentives

- Two-thirds of SB's and 43% of large business report that long-term contracts with indemnification would motivate Industry to facilitate for production. In addition, 43% of large business and a third of SB's said that a high probability of a percent of market share would also motivate Industry.
- The majority of large and small businesses agree that multi-year contracting would incentivize them to make investments to sustain an ammunition production base, improve the technological base, and to remain in the MOB base. About 25% to 35% of both respondent groups also looked favorably upon indemnification.
- The majority of large businesses (62%) report impact on profit for IR&D and B&P spending of 1 to 2 points, and half of these companies say they spend more on this than the allowable reimbursement ceiling provides. Three-fourths of the SB's report an impact of their IR&D and B&P spending of more than 2 points, however only a quarter spend over the allowable reimbursement ceiling.
- The majority of large business (64%) and SB's (50%) advance funds to maintain the running of lines without contract coverage.

There is high level of agreement between large and small businesses that multi-year contracting is a strong motivator to invest in ammunition production base and to remain in the MOB base. While a 100% SB's favor multi-year contracting as an incentive to improve the technical base, about a third of large business also feels that indemnification would motivate them as well.

Level of System for an Ammunition Round

- The majority of Government respondents (67%) chose a full projectile, including LAP as the level of system for an ammunition round. The remaining third selected a loaded projectile, including primary fuze and propelling charges.
- The majority of large and small business respondents see the level of system for an ammunition round consisting of a loaded projectile, including the primary fuze and propelling charges. A third of large business also considered a full projectile as a level of system for this.

Learning Curves

- Compared to Government* respondents, a greater percent of large and small businesses experience higher levels of learning curves both with system contracting with industry and with Government system managed procurements.
- Large business report the widest range of learning curves, while Government respondents show the most consistent (about 80-89%).

Of the three respondent groups, more small businesses (40%) report the lowest learning curves on Government system managed procurements. A small percent of large business (13%) reports both the highest and lowest learning curves (95-99% and 70-79%, respectively). The majority of large businesses (40%) and 40% of SB's as well, report learning curves of 90-94% with Government breakouts. Two-thirds of the Government respondents however, experience moderate learning curves of 85-89%.

On system contracting with Industry, the percent of large and small businesses experiencing low learning curves is evenly matched (about 20%). Somewhat more large businesses than SB's report learning curves at the high end (90-94%). The majority of both SB's (40%) and Government respondents (75%) report learning curves of 85-89% with Industry system contracting.

Warranties

- Only 29% of large and 17% of small businesses report having a warranty clause invoked against their firms.
- However, half of large firms frequently (5 times or more) have done warranty work as an act of good will, compared to a third of SB's. Two-thirds of SB's report hardly ever doing warranty work, while only 43% of large firms report this.
- Both large and small businesses primarily finance warranty work through a mix of tightening quality requirements and increasing the price per unit cost. Slightly more large firms tend to finance their work this way than do small businesses. A larger percent of SB's say they finance warranty work through other means than these.

**Note Nearly half of the Government respondents did not answer the learning curve questions. As a result, the data for this group should be considered incomplete.*

APPENDIX A

ANNOUNCEMENT LETTERS



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AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

DEDICATED TO PEACE WITH SECURITY THROUGH DEFENSE PREPAREDNESS

TWO COLONIAL PLACE, 2101 WILSON BOULEVARD, SUITE 400, ARLINGTON, VIRGINIA 22201-3061

703-522-1820 FAX: 703-522-1885

Government Announcement Letter

Dear {name},

You have been nominated as a key participant in a survey of Government and about forty industry leaders, regarding the subject of Industry System Management of ammunition with a particular emphasis on howitzer rounds. The list of potential respondents on which you have been included is the result of a coordination process which has involved ADPA, the Army Materiel Command (AMC), and their Armament, Munitions, and Chemical Command (AMCCOM).

The survey, which will be forwarded to you in about a week, is a key element of the AMC/AMCCOM Howitzer Ammunition Systems Procurement (HASP) study. This study is being conducted by Alliant Techsystems, Inc. under contract to AMCCOM. The purpose of the study is to understand the potential advantages and disadvantages of the continuing world-wide evolution toward privatization. Budget reductions and new cost accounting methods directed by the DoD Comptroller may not allow the Government to accomplish in-house activities in the same manner as before.

Your candid input is very important to the success of the study. In order to ensure that you can freely respond to the questions in the survey, Questar Data Systems Inc. has been retained to manage the execution and data analysis for the survey. A summary of the survey findings will be available to you through ADPA on, or about, 15 August 1991.

We will be most grateful for your prompt and candid answer to the ADPA Ammunition System Procurement Survey, and thank you in advance for your cooperation.

Very Truly Yours,

MG William G. Eicher
Director of Industry Affairs



Founded 1919

AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

DEDICATED TO PEACE WITH SECURITY THROUGH DEFENSE PREPAREDNESS

TWO COLONIAL PLACE, 2101 WILSON BOULEVARD, SUITE 400, ARLINGTON, VIRGINIA 22201-3061

703-522-1820 FAX: 703-522-1885

Industry Announcement Letter

Dear {name},

You have been nominated as a key industry participant in a survey of Government and about forty industry leaders, regarding the subject of Industry System Management of ammunition, with a particular emphasis on howitzer rounds. The list of potential respondents on which you have been included is the result of a coordination process which has involved ADPA, the Army Materiel Command (AMC) and their Armament, Munitions, and Chemical Command (AMCCOM).

The survey, which will be forwarded to you in about a week, is a key element of the AMC/AMCCOM Howitzer Ammunition Systems Procurement (HASP) study. This study is being conducted by Alliant Techsystems, Inc. under contract to AMCCOM. The purpose of the study is to understand the potential advantages and disadvantages of the continuing world-wide evolution toward privatization. Budget reductions and new cost accounting methods directed by the DoD Comptroller may not allow the Government to accomplish in-house activities in the same manner as before. It is essential that the ammunition community change to maintain a high level of performance, despite the budget declines.

Your candid input is very important to the success of the study. In order to ensure that you can freely respond to the questions in the survey, Questar Data Systems Inc. has been retained to manage the execution and data analysis for the survey. A summary of the survey findings will be available to you through ADPA on, or about, 15 August 1991.

We will be most grateful for your prompt and candid answer to the ADPA Ammunition System Procurement Survey, and thank you in advance for your cooperation.

Very Truly Yours,

MG William G. Eicher
Director of Industry Affairs
American Defense Preparedness Association

APPENDIX B

COVER LETTERS
QUESTIONNAIRES



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703-522-1820 FAX: 703-522-1885

Government Cover Letter

Dear {name},

I want to thank you in advance for completing the following survey. As I stated in the letter you received earlier, this survey is part of a larger study (the AMC/AMCCOM Howitzer Ammunition Systems Procurement study) that we are undertaking. The objective of the study is to understand the potential advantages and disadvantages of the continuing world-wide evolution toward privatization. This survey in particular will provide insight into the issues surrounding the world-wide trend toward Industry System Management.

You are part of a select group of Government leaders we are asking to participate in this survey. ADPA believes that an open discussion of what motivates Industry to manage systems is important to the relationship between Government and Industry. As you respond to the survey questions, I encourage you to express your insights and consider alternatives to the existing Government-Industry relationship.

Questar Data Systems Inc. has been retained to manage the data processing and analysis of the survey, working with ADPA and Alliant Techsystems. It is possible that you may be contacted for oral follow-up to this questionnaire.

Upon your request, ADPA will provide you with a summary of the survey findings (results available on, or about, 15 August 1991). Please use the enclosed addressed envelope to return your survey, or fax it directly to Questar at 612/688-0546.

Very Truly Yours,

MG William G. Eicher
Director of Industry Affairs
American Defense Preparedness Association



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703-522-1820 FAX: 703-522-1885

Industry Cover Letter

Dear {name},

I want to thank you in advance for completing the following survey. As I stated in the letter you received earlier, this survey is part of a larger study (the AMC/AMCCOM Howitzer Ammunition Systems Procurement study) that we are undertaking. The objective of the study is to understand the potential advantages and disadvantages of the continuing world-wide evolution toward privatization. This survey in particular will provide insight into the issues surrounding the world-wide trend toward Industry System Management.

You are part of a select group of Industry leaders we are asking to participate. As you respond to the survey questions, I encourage you to express your insights and consider alternatives to the existing Government-Industry relationship.

We are also sensitive to the importance of the information you provide in this survey. In order to ensure that you freely respond to the questions in the survey, Questar Data Systems Inc. has been retained to manage the data processing and analysis of the survey.

Upon your request, ADPA will provide you with a summary of the survey findings (results available on or about 15 August 1991). Please use the enclosed addressed envelope to return your survey, or fax it directly to Questar at 612/688-0546. Remember, the results of this survey will have an impact on your industry and this is your chance to help shape the future.

Very Truly Yours,

MG William G. Eicher
Director of Industry Affairs
American Defense Preparedness Association

HOWITZER AMMUNITION SYSTEMS
PROCUREMENT SURVEY

April 1991

INTRODUCTION AND DEFINITIONS

For a military item which is not managed by a dedicated project manager through the Program Executive Officer (PEO) system, the systems integration and management may either be accomplished in-house by the Government, or contracted out to Industry. *Government Systems Management* is popularly referred to as "break-out", while *contracting to Industry* is usually called "systems contracting".

Where **systems contracting** is done in the case of ammunition, this may frequently involve either "third-party contracting" with GOCO explosives loading (LAP) plants, or private ownership of those types of facilities.

The following questions are designed to elicit your views on the characteristics of each method of acquisition. Where the question does not otherwise discuss the definition of "system", you should assume that this means either an all-up large-caliber ammunition round, or the munition with its dispenser also. For example, a system could be a Copperhead round, a DPICM, or a tank ammunition cartridge. It will not normally include the howitzer or gun tube for the purposes of this questionnaire; but, it could include a rocket launcher or missile tube, or even a smaller caliber gun with its ammunition -- logic should prevail. Please relate the following questions to the ammunition or missile projects in which your firm is involved.

OPTIONAL -- You may answer anonymously or for attribution.

Name: _____

Title: _____

Telephone: _____

1. Where along the following scale does maximum accountability lie for each of the following : (Please circle the number that corresponds to your answer.)

	<u>Government</u> <u>Control</u>			<u>Industry</u> <u>Control</u>	
a) Cost management	1	2	3	4	5
b) Readiness for field use	1	2	3	4	5
c) Technical success	1	2	3	4	5
d) Technical failure	1	2	3	4	5
e) Schedule management	1	2	3	4	5

2. Using the following scale, which system management approach is more conducive to:

	<u>Government Control</u>				<u>Industry Control</u>
a) Best quality	1	2	3	4	5
b) Best technology approach	1	2	3	4	5
c) Timely delivery of end item	1	2	3	4	5
d) Continuous product improvement	1	2	3	4	5
e) Innovation	1	2	3	4	5
f) Lowest total cost	1	2	3	4	5
g) True competition	1	2	3	4	5
h) Timely and efficient contracting	1	2	3	4	5

3. What is the optimal Government-Industry relationship in the following elements of the acquisition process:

	<u>Government Control</u>				<u>Industry Control</u>
a) Design/Development	1	2	3	4	5
b) Production	1	2	3	4	5

What, if any, major barriers to this optimal relationship do you see?

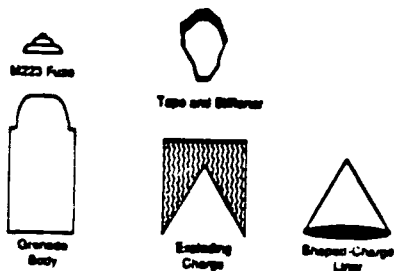
4. What do you think is the level of "system" for an ammunition round? (Please refer to the illustrations below for clarification of each response choice.) Please circle only one number that corresponds to your answer.

1. Component of submunition
2. Submunition
3. Full projectile, less LAP
4. Full projectile, including LAP
5. Loaded projectile, including primary fuze and propelling charges

Illustrations (Example Used is M483 DPICM Round)

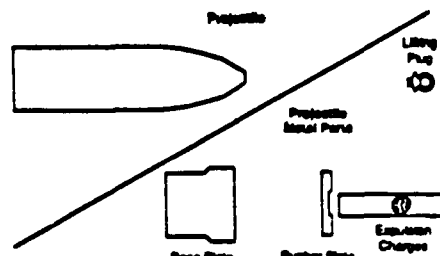
Response 1 (one component only)

Submunition Components (25 of each)



Response 3 (All items shown)

Submunitions (25)



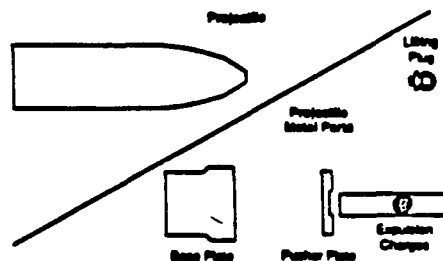
Response 2

Submunitions (25)



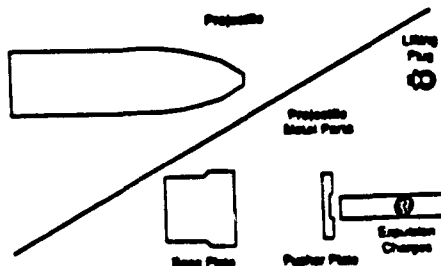
Response 4 (All items shown, including LAP)

Submunitions (25)



Response 5 (All items shown)

Submunitions (25)

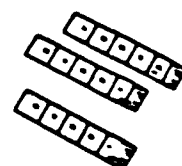


Primary Fuze



M702 Electronic Time

Propelling Charges



5. DoD major system evaluation instructions call for selecting the "best value". What do you think are the appropriate "best value" criteria for procurement by the Government? Please circle only one, two, or three factors, and then rank these to the left, in order of importance.

- ☐ Contract cost
- ☐ Quality
- ☐ Mobilization and readiness
- ☐ Warranties
- ☐ Schedule
- ☐ UPC
- ☐ Management capability
- ☐ Life cycle cost
- ☐ Other (please specify): _____

Would these criteria be accepted by Industry? Why or why not?

Would these criteria be accepted by the Government? Why or why not?

6. Assuming the overall role of the Government is to obtain the highest quality at the lowest price, do you feel that "price only" competition provides the "best value" to the Government? (Please circle the number that corresponds to your answer.)

- 1. Yes
- 2. No

Please comment on your answer.

7. What is the best way to balance readiness with the need for competition?

8. In your opinion, what critical skills and technology capabilities are needed to retain an effective howitzer ammunition base?

9. Taking into consideration all the recent changes, such as budget reductions and the world situation, how have these changes altered your opinion of Government System Management versus Industry System Contracting? Please comment:

10. To what extent do you see each of the following promoting TQM (Total Quality Management) with its suppliers?

	<u>To a very large extent</u>	<u>To a large extent</u>	<u>To some extent</u>	<u>To a little extent</u>	<u>To almost no extent</u>
a) The Government	1	2	3	4	5
b) Industry	1	2	3	4	5

11. Given the official DoD definition of TQM (see below), which of the following contracting methods do you think is more compatible with the desire to implement TQM?

Total Quality Management Definition: TQM is both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. TQM is the application of quantitative methods and human resources to improve the material and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customer are met, now and in the future. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continuous improvement.

1. Government System Management (or break-out)
2. Industry System Contracting
3. Other (please specify): _____

12. In your opinion, what promotes TQM or quality improvement in Industry?

13. What causes Industry to make product improvements to Government items?

14. A Contractor Certification Program (CCP) is a key element of the AMC program to implement TQM in its vendor base. Should potential contractors be required to be certified in order to be eligible for award?

1. Yes, contractor certification should be required.
2. No, contractor certification should not be required.

How should the RFP/Contract requirements affect this?

15. What do you think would incentivize Industry to increase small business and SDB subcontracting?

16. Would you, if a prime, be willing or able to furnish small business and SDB subcontracting information to the Government (without compensation) to allow better goal measurement?

1. Yes
2. No

Please comment on your answer.

17. How would you rate the following aspects of Government TDP's:

	<u>Very Good</u>	<u>Good</u>	<u>Neutral</u>	<u>Poor</u>	<u>Very Poor</u>
a) Quality of TDP's	1	2	3	4	5
b) Producibility of TDP's	1	2	3	4	5

How should TDP maturity play into the determination of the acquisition approach?

18. What action does your company usually take if your company finds a problem with a TDP?

1. Correct the TDP as part of the program
2. Notify the Government and request technical assistance
3. File a request for waiver with the Government
4. File financial claims against the Government
5. Other (please specify): _____

19. How can the form-fit-function (F³) approach, otherwise known as "performance specification" in lieu of build-to-print, be made compatible with the need for competition?

20. How often has your company encountered problems with GFM on each of the following:

	<u>Almost Always</u>	<u>Often</u>	<u>Sometimes</u>	<u>A Little</u>	<u>Never</u>
a) Schedule	1	2	3	4	5
b) Function/fitment	1	2	3	4	5

If there were problems, what were the relative cost impacts? If possible, please describe the program and circumstances (if necessary to maintain anonymity, describe product generically).

21. Does your company file claims when GFM causes difficulty in the production process?

1. Yes
2. No

Why or why not?

22. On average, what learning curves have you experienced with:

	<u>99-95%</u>	<u>94-90%</u>	<u>89-85%</u>	<u>84-80%</u>	<u>79-70%</u>
a) Government system managed (break-out) procurements	1	2	3	4	5
b) System contracting with Industry	1	2	3	4	5

23. What would incentivize your company to:

	<u>Annual Breakout, Winner-Take-All Competition</u>	<u>System Contracting</u>	<u>Multi-Year Contract</u>	<u>Guaranteed Quantity Or Indemnification</u>
a) Make investments to sustain an ammunition production base	1	2	3	4
b) Improve the technological base	1	2	3	4
c) Remain in the MOB base	1	2	3	4

24. Which of the following conditions would motivate your company to facilitate for production? (Please choose only one answer.)

1. Annual competitions in a stable market
2. Long-term contracts with indemnification
3. A high probability of a percentage of market share
4. Other (please specify): _____

Please comment on any additional motivators:

25. In your opinion, what are the appropriate roles for both Government and Industry in indemnification?

26. Does your company advance funds to keep a production line running without contract coverage?

1. Yes
2. No

27. Does your company usually spend more for IR&D and B&P than your allowable reimbursement ceiling?

1. Yes
2. No

28. What is the approximate impact on profit (as a percentage of total sales) for IR&D and B&P spending?

1. Little impact
2. 1 or 2 points
3. More than 2 points

29. Under what conditions would your company maintain a ready production capability to produce a round of ammunition without Government funding?

30. Given that Industry overall is spending money on cost reduction, how much more should your company be investing in quality improvement rather than on cost reduction?

1. 50% or greater
2. 49-40% more
3. 39-30% more
4. 29-20% more
5. 19-10% more
6. Less than 10%

31. What would motivate your company to invest in VECP?

32. Has your company ever had a warranty clause invoked against it?

1. Yes
2. No

33. How many times has your company voluntarily done warranty work on Government programs as an act of good will?

1. Very often (more than 10 times)
2. Often (about 5 to 10 times)
3. Seldom (about 5 times)
4. Hardly ever (once or twice)
5. Never

34. How does your company primarily finance warranties?

1. Tightening quality requirements
2. Increasing the price per unit cost
3. Other (please specify): _____

What do you feel are the real value and effectiveness of warranties?

35. Should the Government have any role in promoting foreign sales beyond ensuring that US interests are protected?

1. Yes
2. No

If you answered yes, what additional role should the Government assume?

36. What is the best Industry role in promotion of FMS sales?

37. How does systems contracting versus break-out impact Industry's ability and incentive to market U.S. ammunition overseas?

38. What portion of your company's sales base is foreign?

	<u>None</u>	<u>1-10%</u>	<u>11-20%</u>	<u>21-30%</u>	<u>31-40%</u>	<u>41-50%</u>	<u>Over 50%</u>
a) Direct "commercial sales"	1	2	3	4	5	6	7
b) FMS case marketed by your your company	1	2	3	4	5	6	7

39. What type of company is your firm: (Please choose only **one** answer.)

1. Build-to-print.
2. Maintain own R&D technology base.
3. "Full service" R&D and production for ammunition or missile systems.

40. Does your company maintain its own full round test facilities?

1. Yes
2. No

Why, or why not?

41. Would you use Government test facilities more often if they were readily available and economical?

1. Yes
2. No

42. What part of your company's sales base is: (Please circle only one answer each for "a" and "b".)

	<u>0-10%</u>	<u>11-20%</u>	<u>21-30%</u>	<u>31-40%</u>	<u>41-50%</u>	<u>51-60%</u>	<u>61-70%</u>	<u>71-80%</u>	<u>81-90%</u>	<u>91-100%</u>
a) Government System Managed (or break-out)	<u>1</u>	2	<u>3</u>	4	5	6	<u>7</u>	8	9	10
b) System contracting with Industry	<u>1</u>	2	<u>3</u>	4	5	6	<u>7</u>	8	9	10

43. Is your company usually:

1. A prime contractor
2. A sub-contractor

If your company operates a GOCO, please answer questions 44-45 on the next page.

44. What is your preferred way to do "third party contracting":

1. With Government workloading
2. With Industry System Primes

Why do you prefer this?

45. Which of the following instances do you find that your production process runs the most smoothly with respect to:

	<u>GFM</u>	<u>Plant Procured Material</u>	<u>Prime Furnished Material</u>
a) Scheduling	1	2	3
b) Function of parts and configuration fitment	1	2	3

Please provide an example of where a change in one way or the other has made a difference in the production process.
Estimate the possible cost impacts of this change.

Thank you for participating.

APPENDIX C

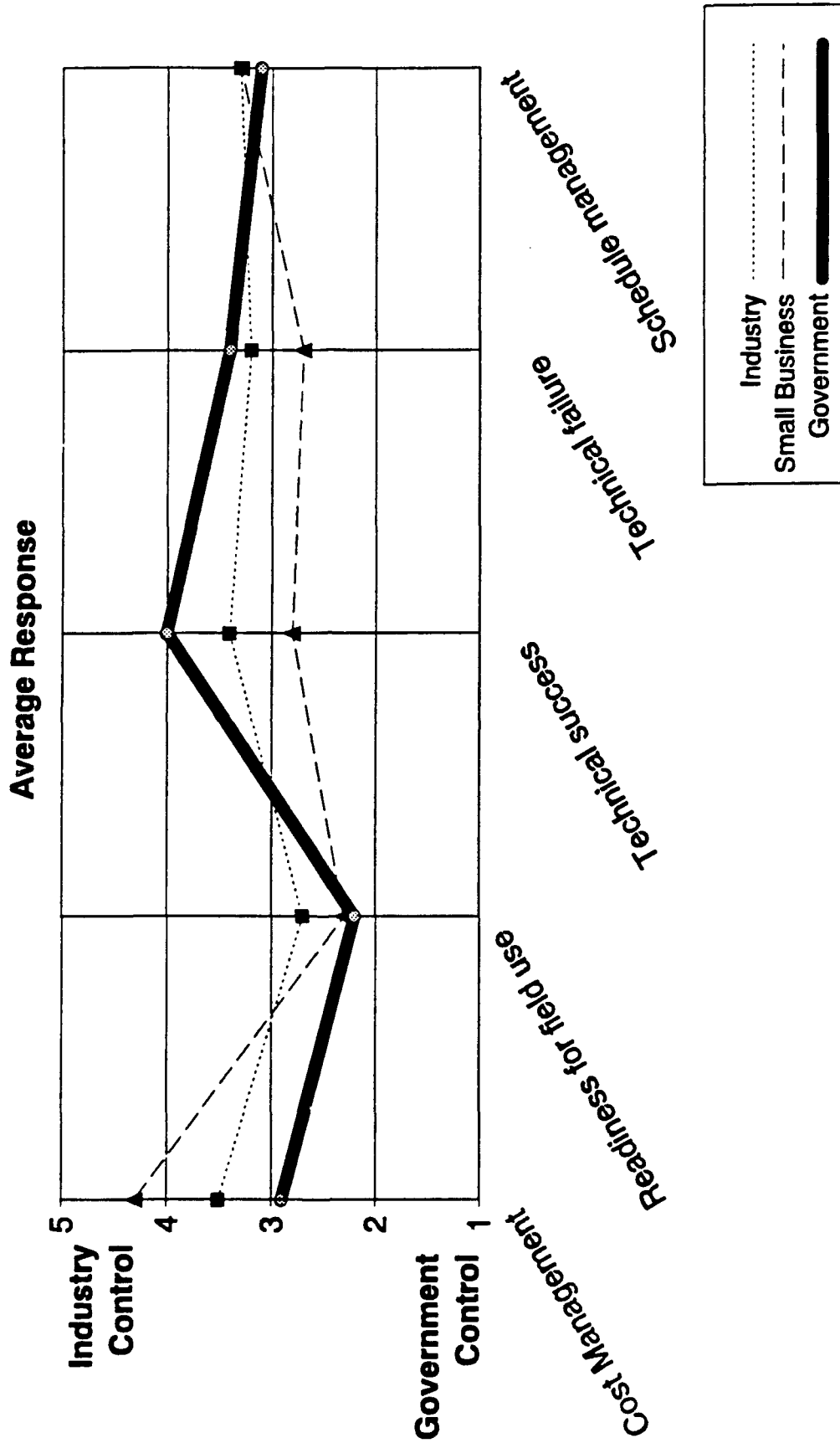
GRAPHS OF SURVEY RESULTS

Howitzer Ammunition Systems Procurement Survey

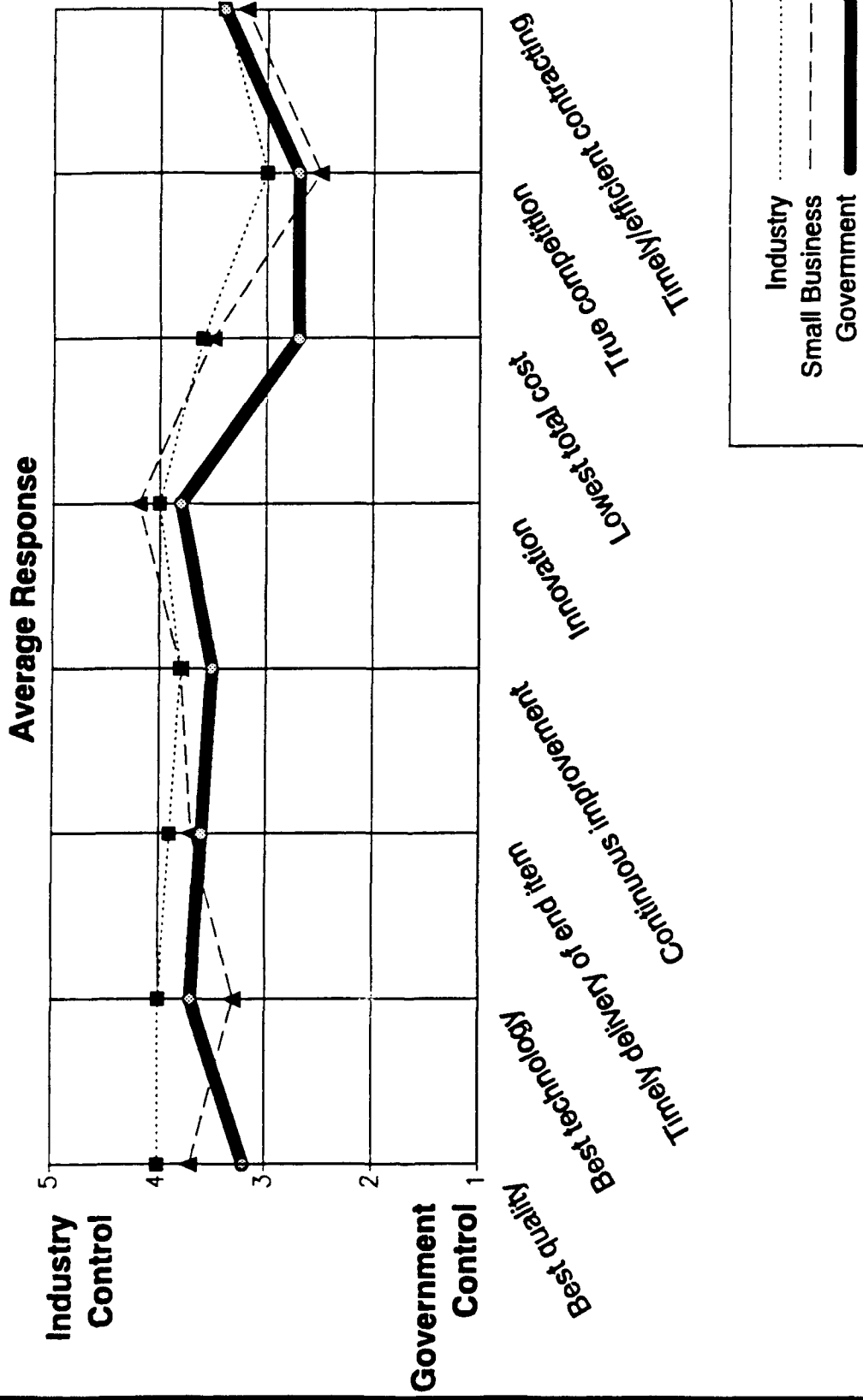
Graphs of Results

**Questar Data Systems, Inc.
June 1991**

Where (between Industry control and Government control) does maximum accountability lie for each of the following:

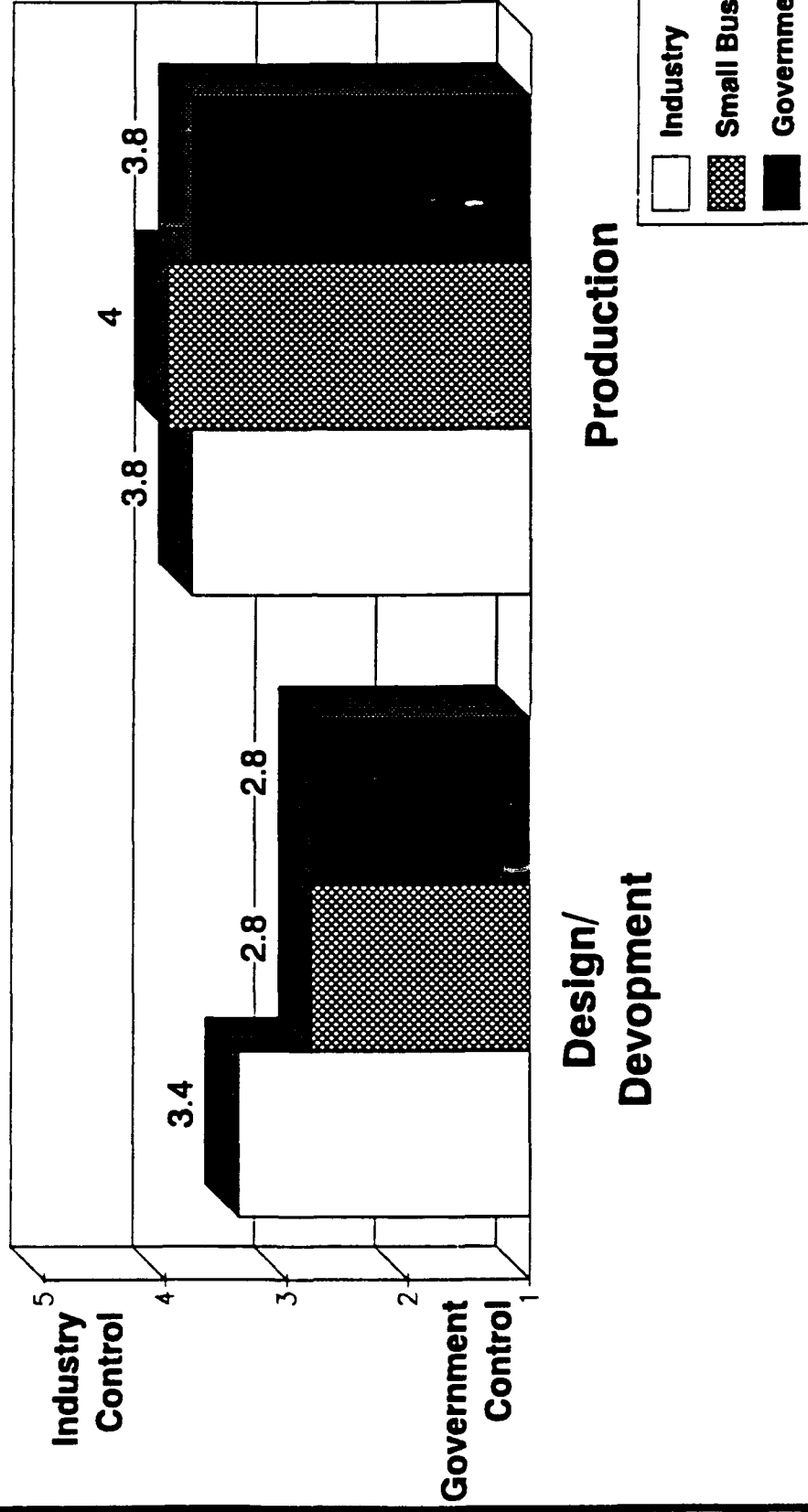


Which system management approach is more conducive to:

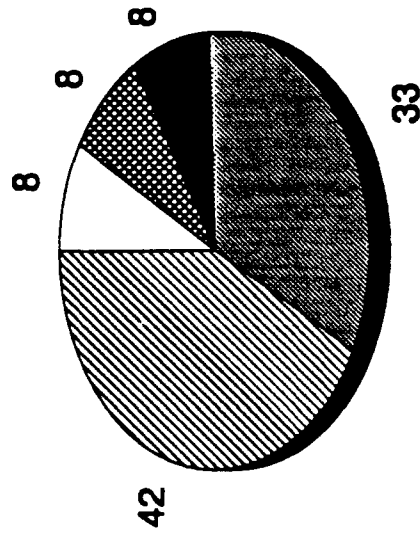


What is the optimal Government-Industry relationship in the following elements of the acquisition process?

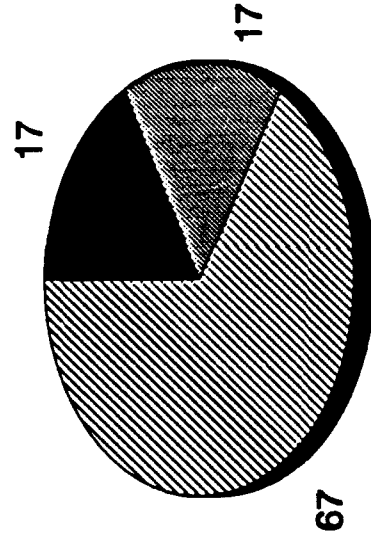
Average Response



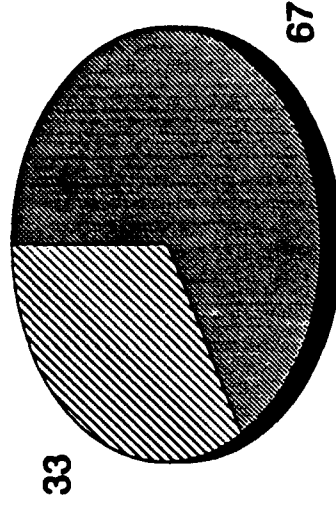
Perceived level of system for an ammunition round.



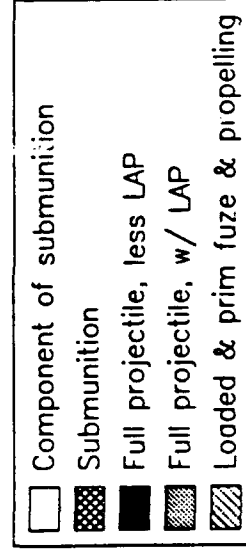
Industry



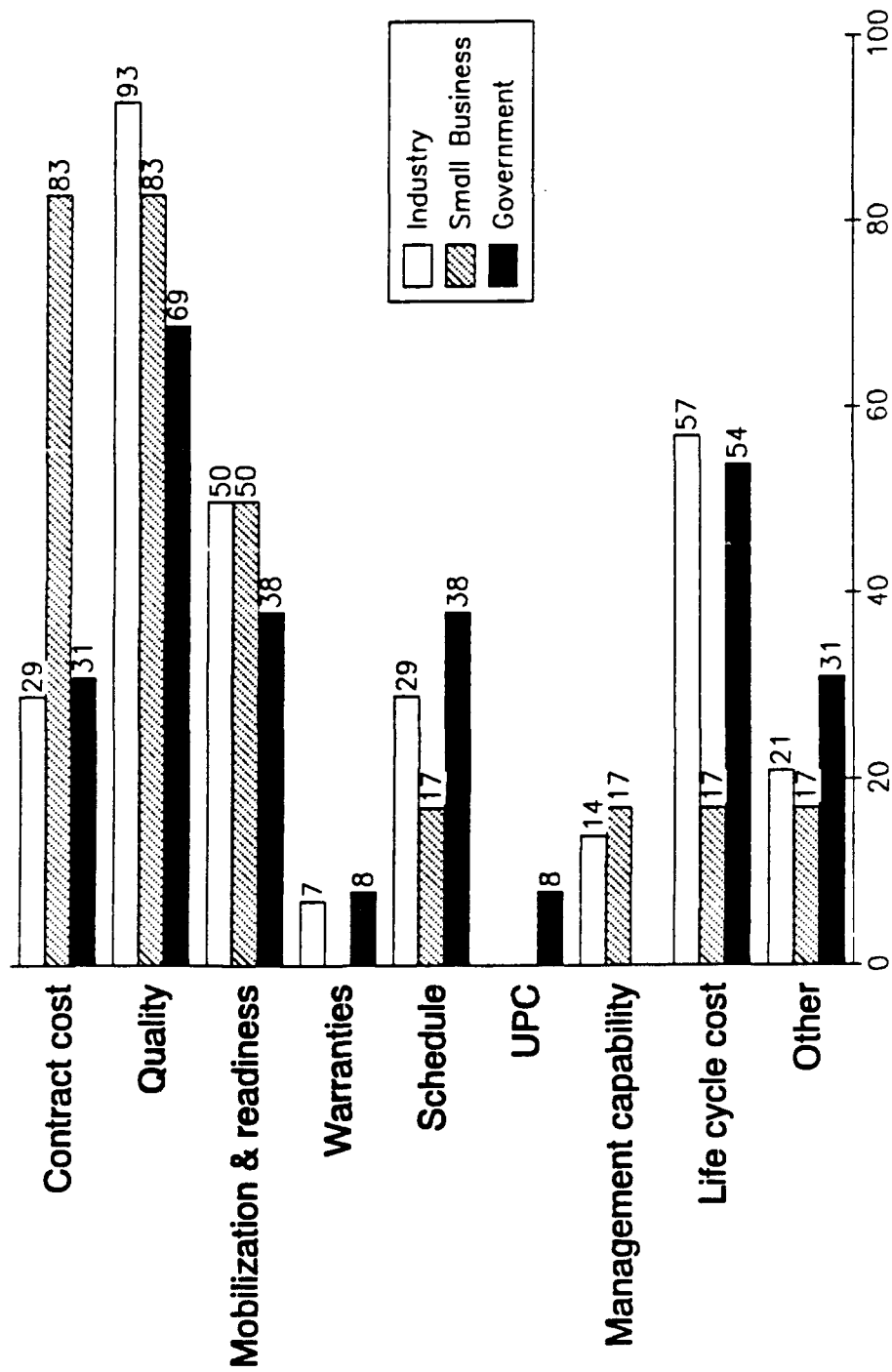
Small Business



Government

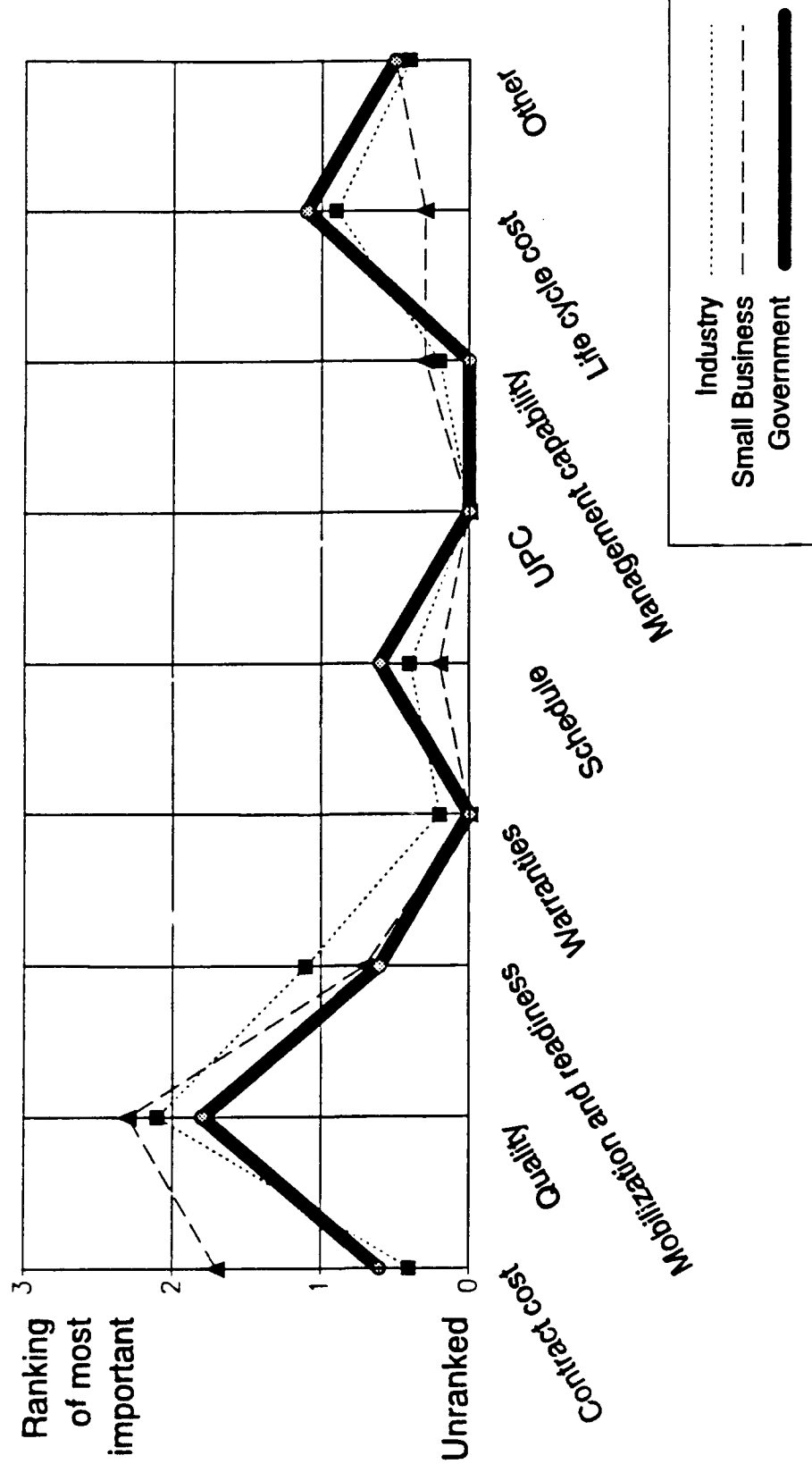


What are the appropriate "best value" criteria for procurement by the Government.

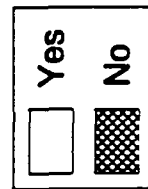
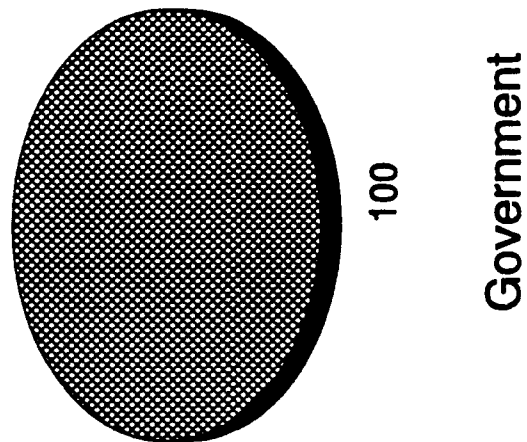
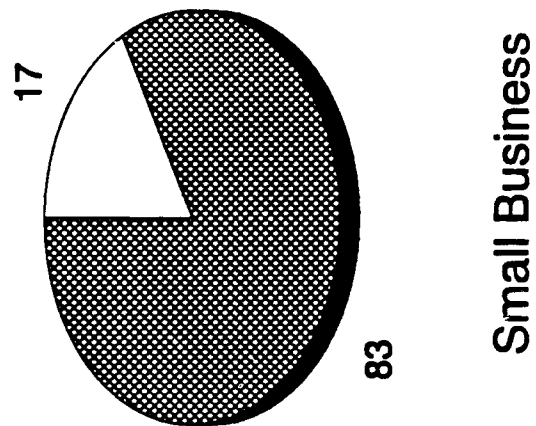
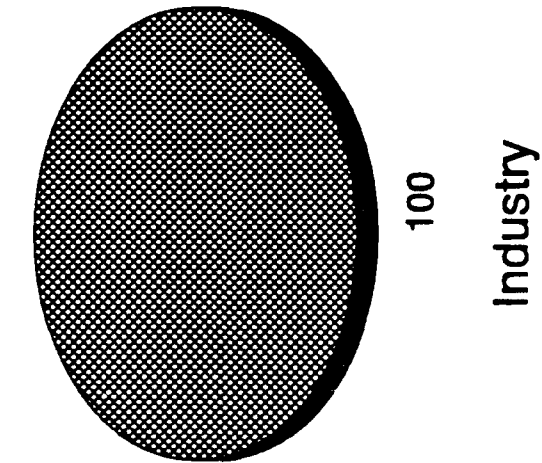


Ranking of "best value" criteria for procurement by the Government.

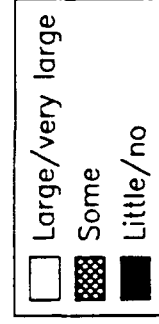
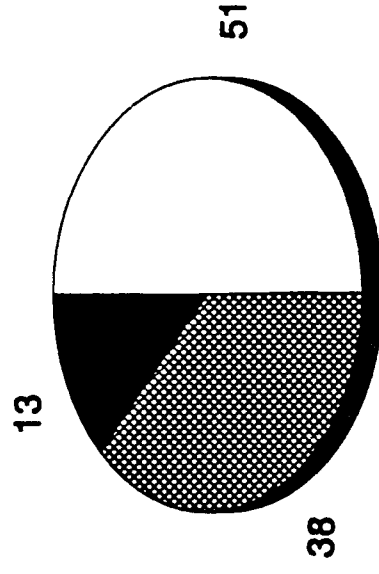
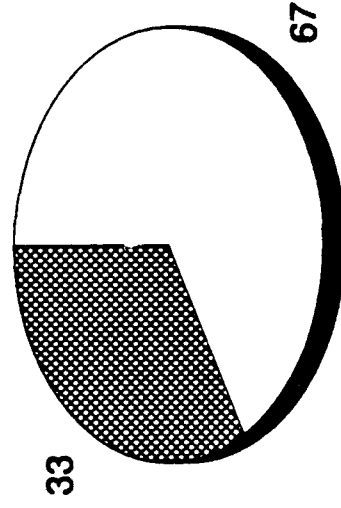
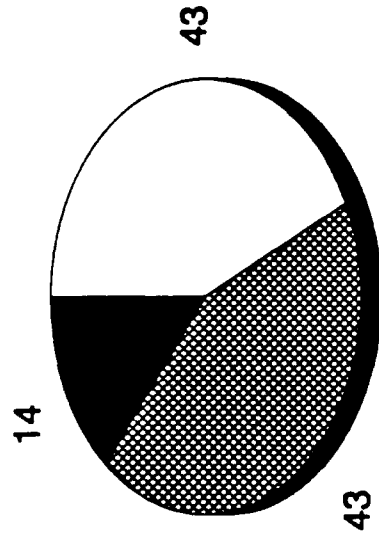
Average Response



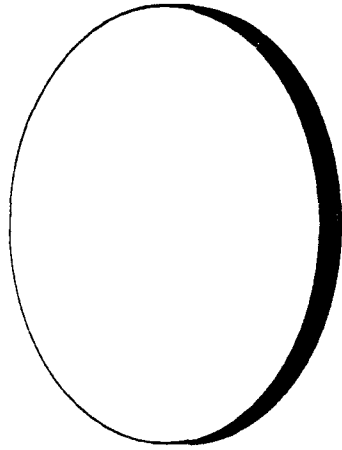
Does price-only competition provide the "best value" to the Government?



To what extent does Government promote TQM with its suppliers?

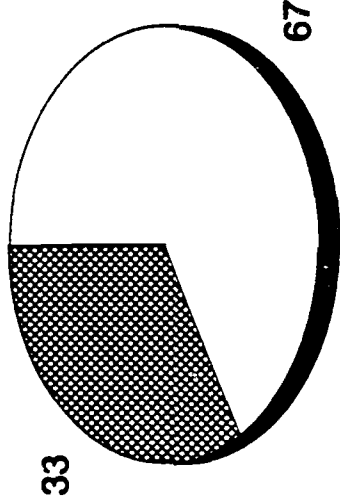


To what extent does Industry promote TQM with its suppliers?



100

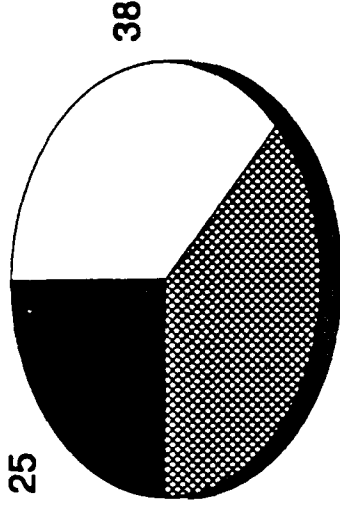
Industry



33

67

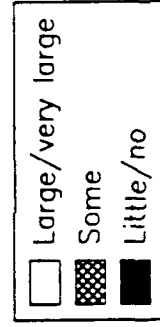
Small Business



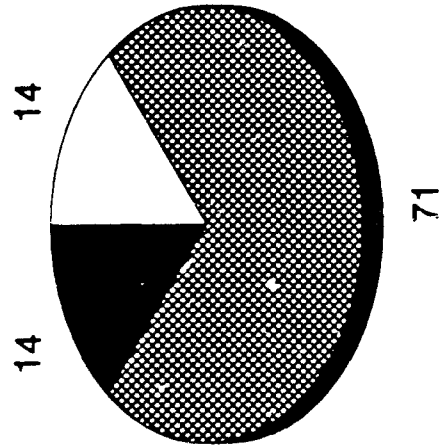
25

38

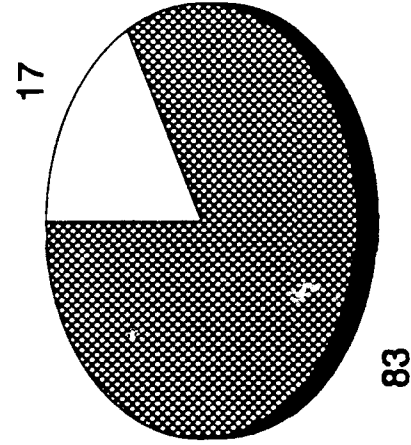
Government



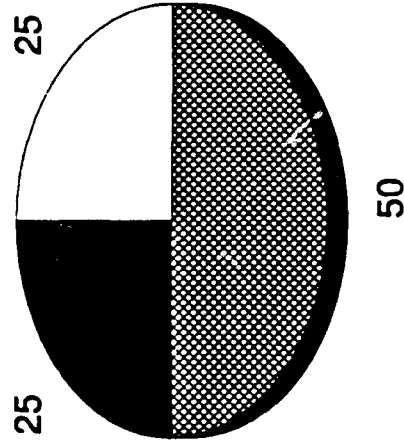
The contracting method more compatible with the desire to implement TQM.



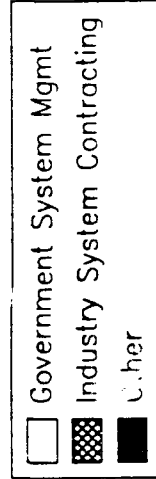
Industry



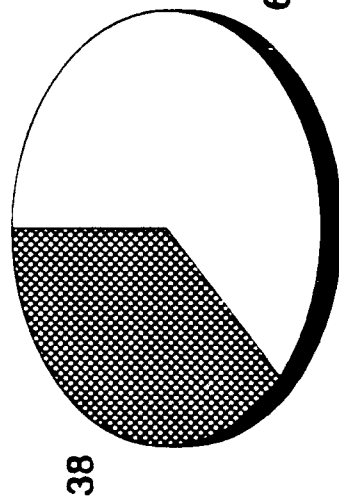
Small Business



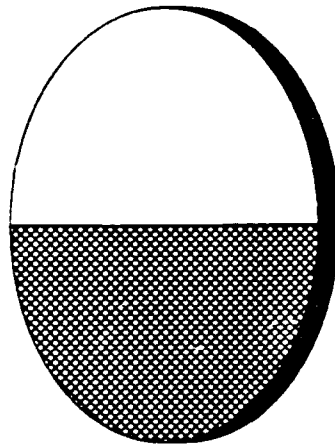
Government



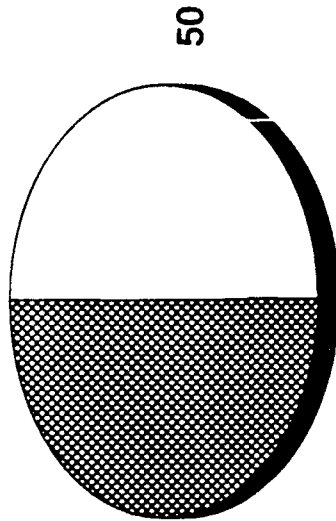
Required certification of potential contractors to be eligible for award.



Industry



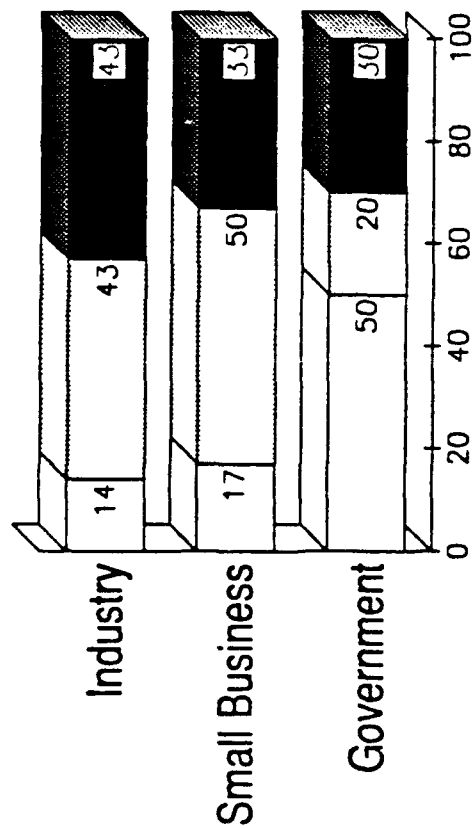
Small Business



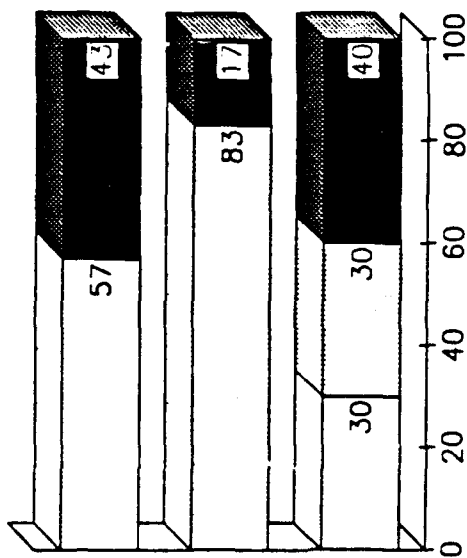
Government

☐ Yes, contractor certification should be required
☒ No, contractor certification should not be required

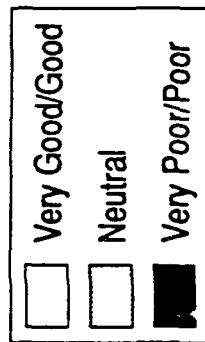
Rate the following aspects of Government TDP's:



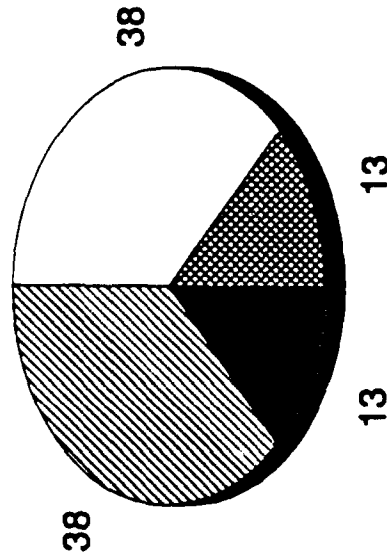
Quality of TDP's



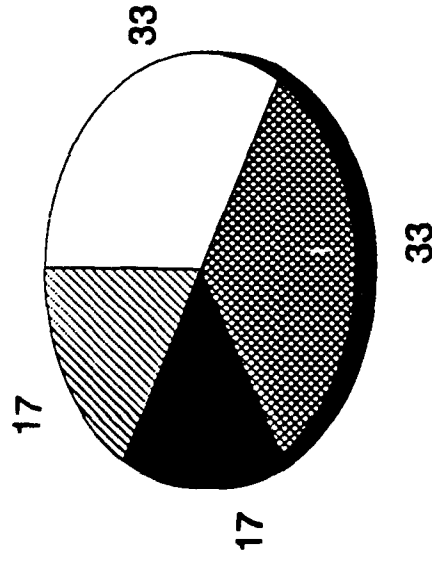
Producibility of TDP's



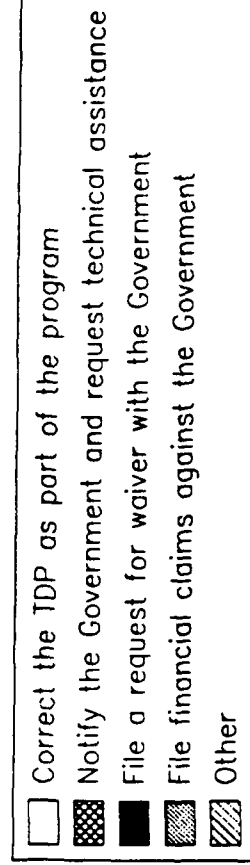
What action does your company usually take if your company finds a problem with a TDP?



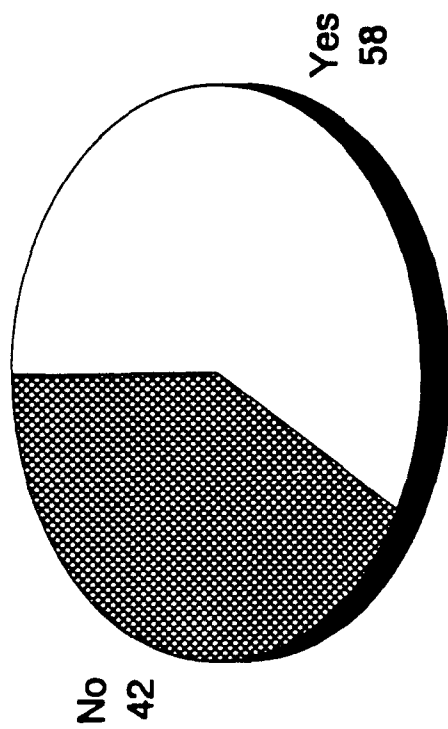
Industry



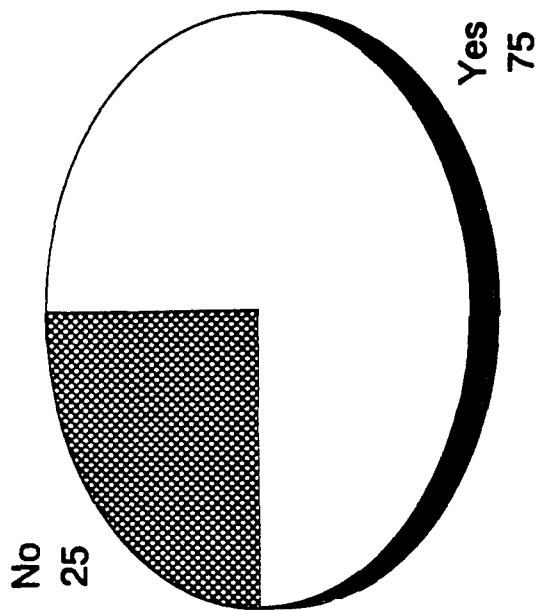
Small Business



Does your company file claims when GFM causes difficulty in the production process?

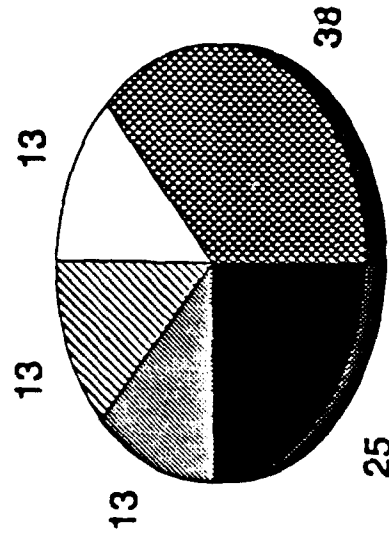


Industry



Small Business

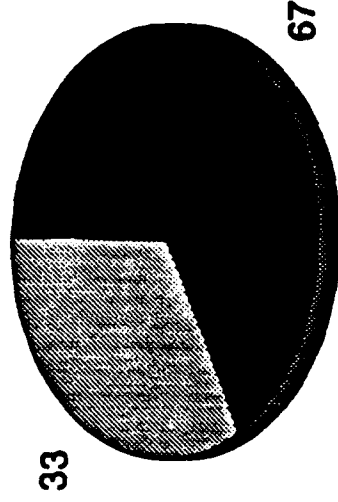
Learning curve with Government system managed procurements.



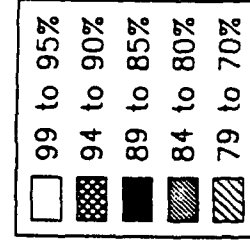
Industry



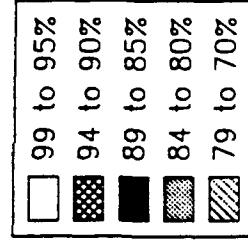
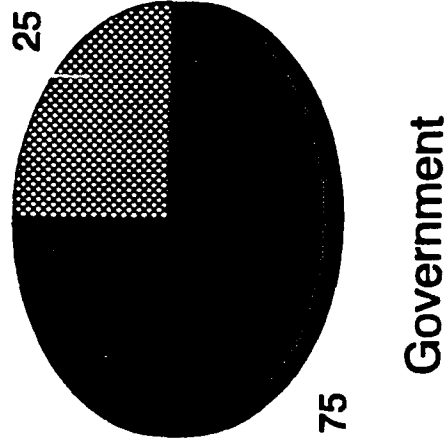
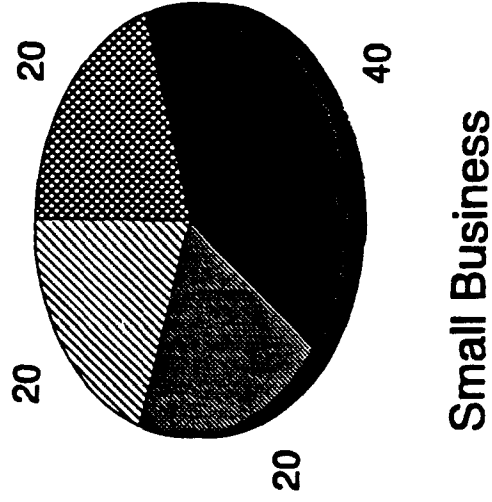
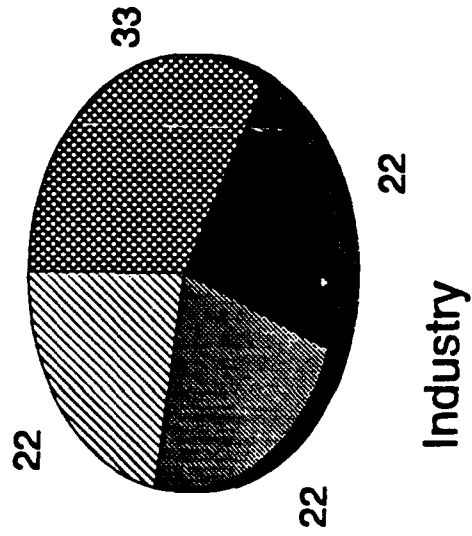
Small Business



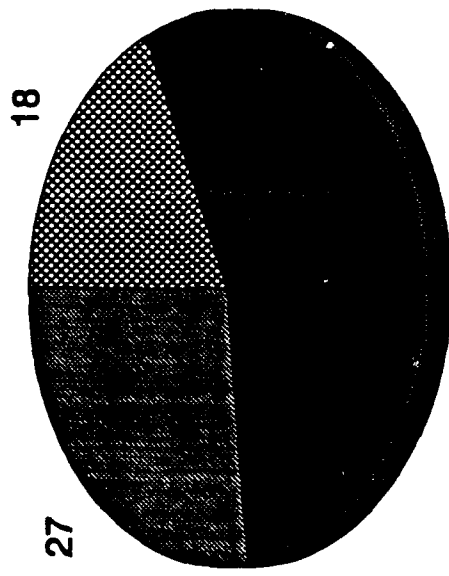
Government



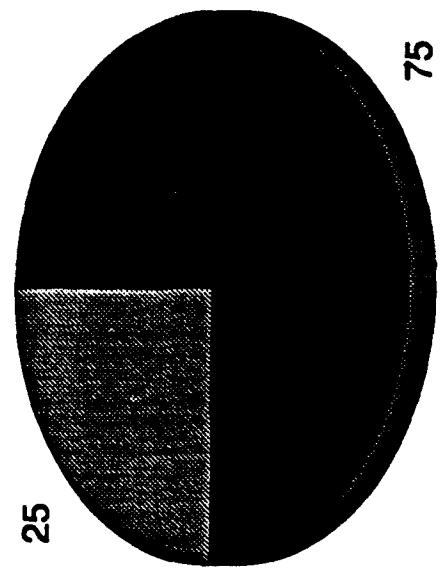
Learning curve with system contracting with Industry.



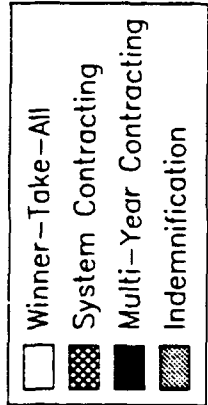
What would Incentivize your company to make investments to sustain an ammunition production base?



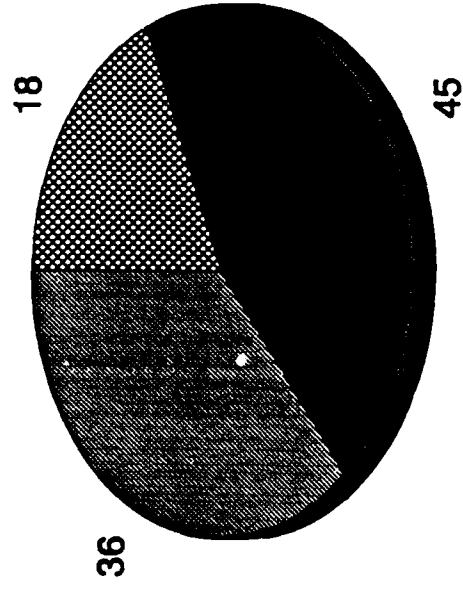
Industry



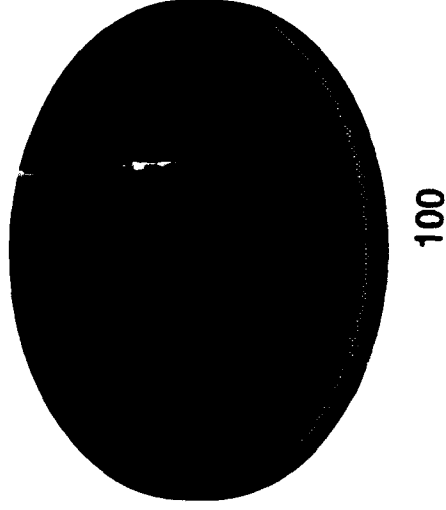
Small Business



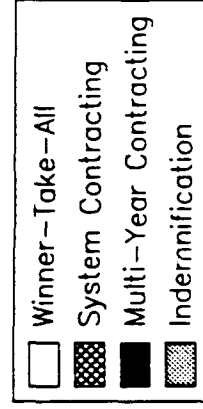
What would incentivize your company to improve the technological base?



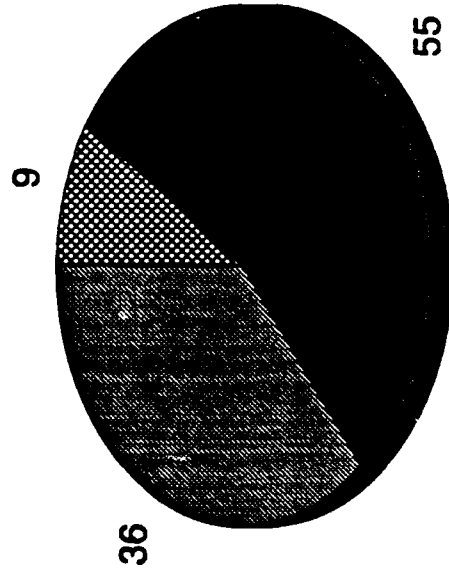
Industry



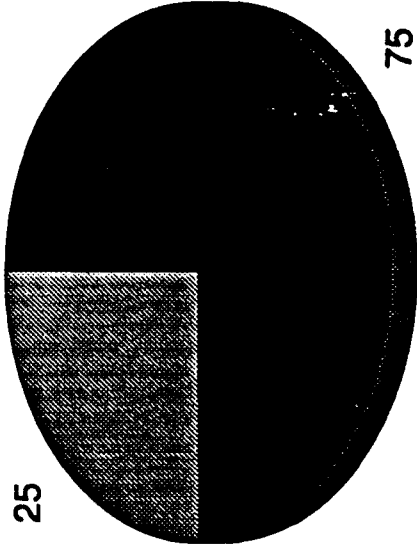
Small Business



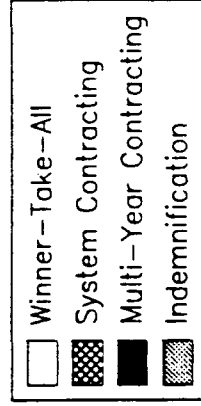
What would incentivize your company to remain in the MOB base?



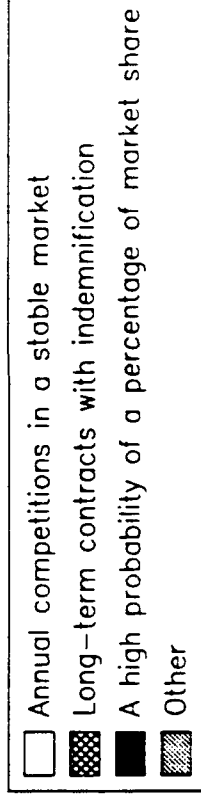
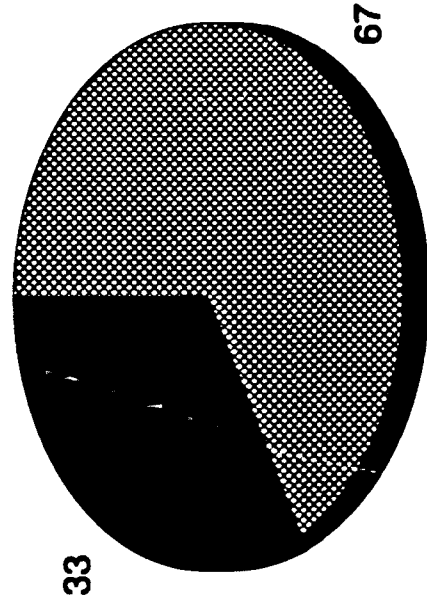
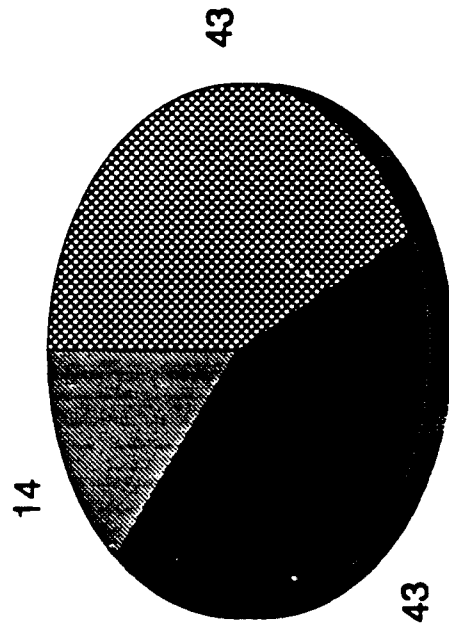
Industry



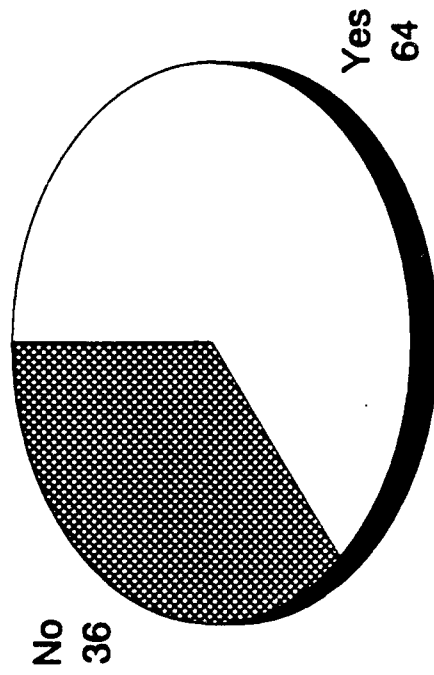
Small Business



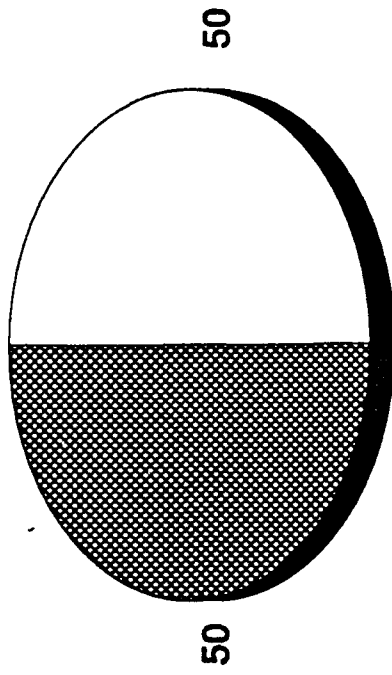
Conditions that motivate Industry to facilitate for production.



Advancement of funds to maintain running of lines without contract coverage.

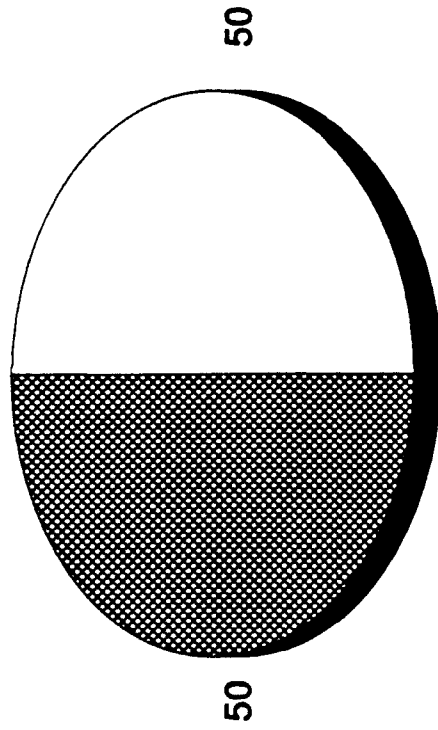


Industry

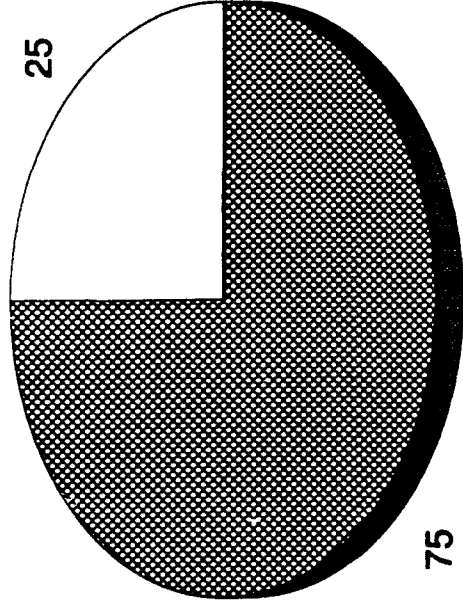


Small Business

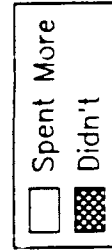
Amount spent for IR&D and B&P over allowable reimbursement ceiling.



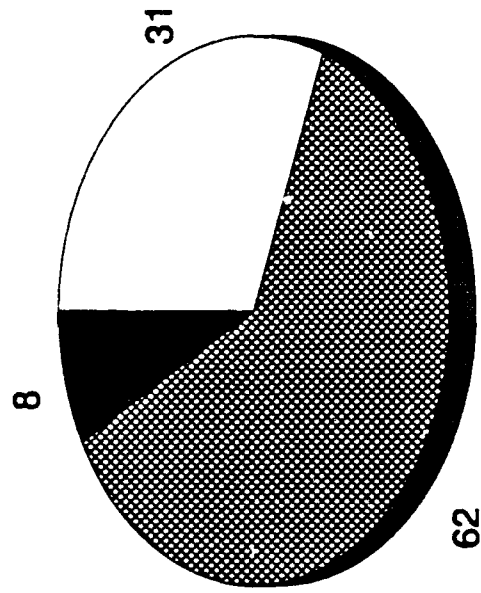
Industry



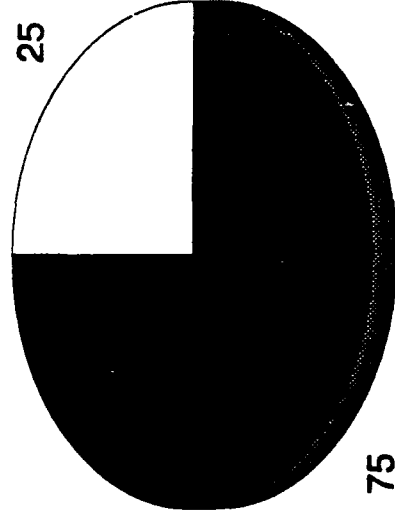
Small Business



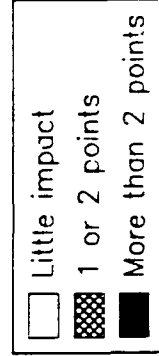
IR&D and B&P spending impacts on profit.



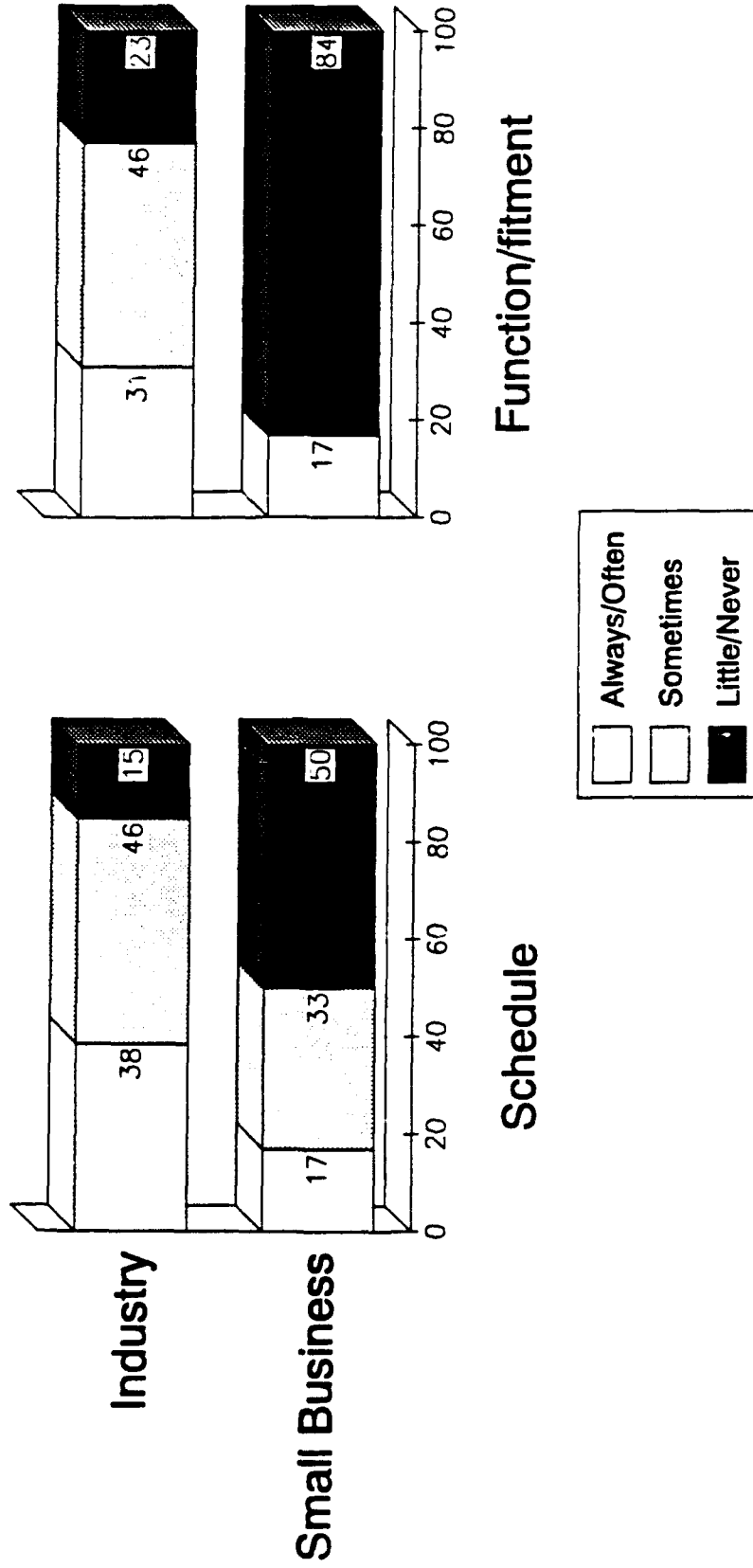
Industry



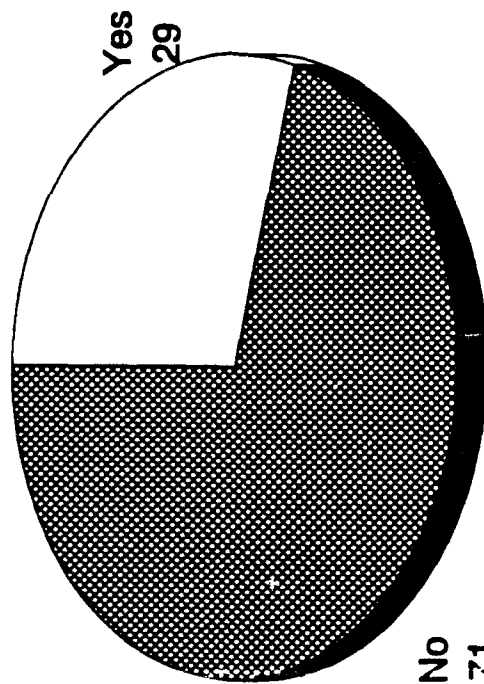
Small Business



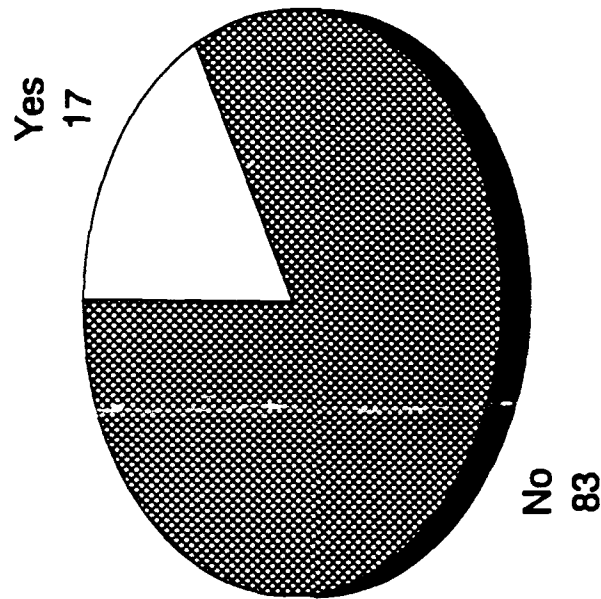
How often has your company encountered problems with GFM on each of the following?



Incidence of warranty clause invoked against a company

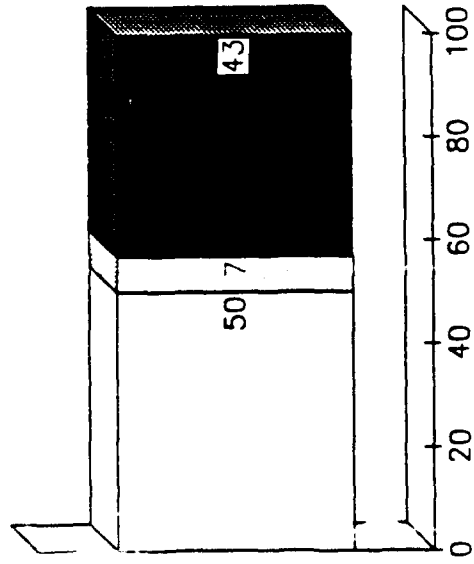


Industry

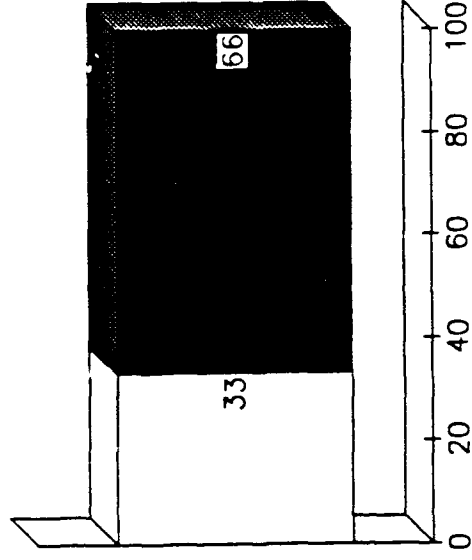


Small Business

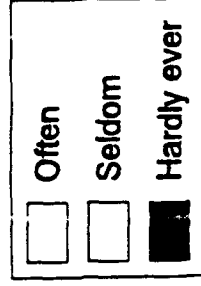
Frequency of voluntary warranty work as an act of good will.



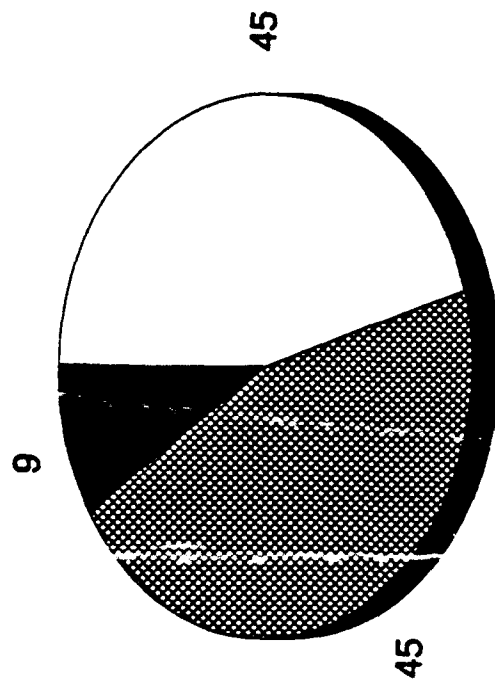
Industry



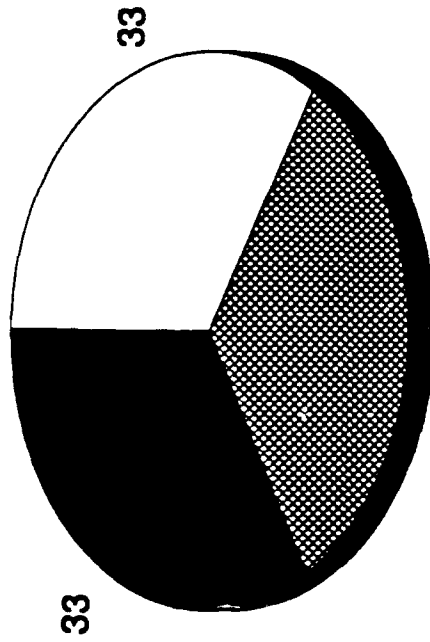
Small Business



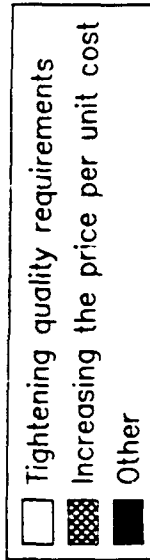
Primary financing of warranties.



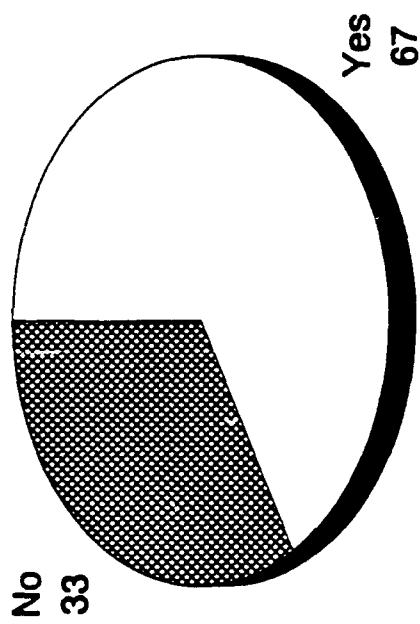
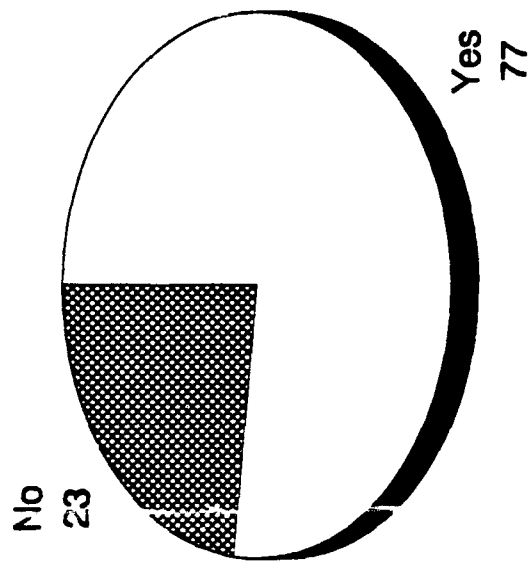
Industry



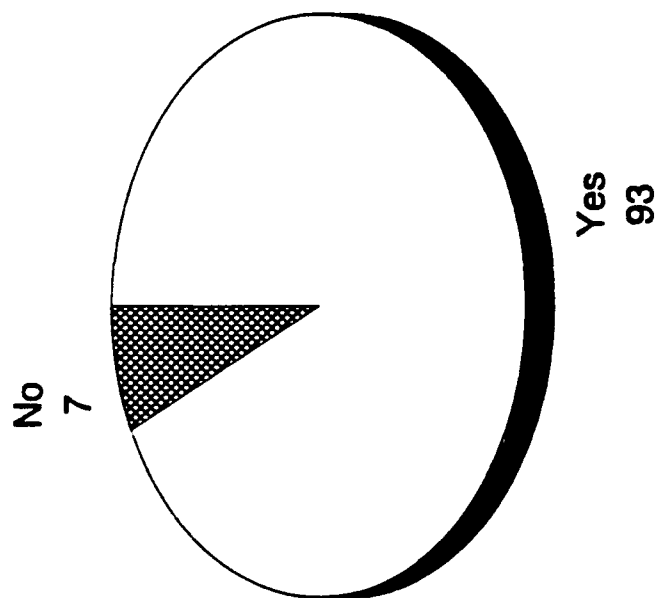
Small Business



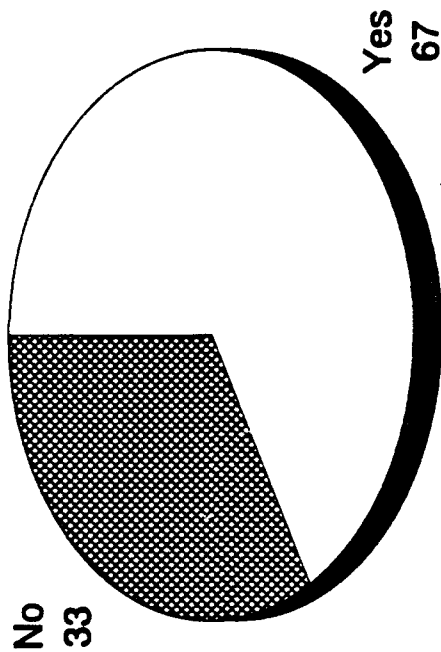
Would you use Government test facilities more often if they were readily available and economical?



Should Government have a role in promoting foreign sales beyond protecting U.S. interests?



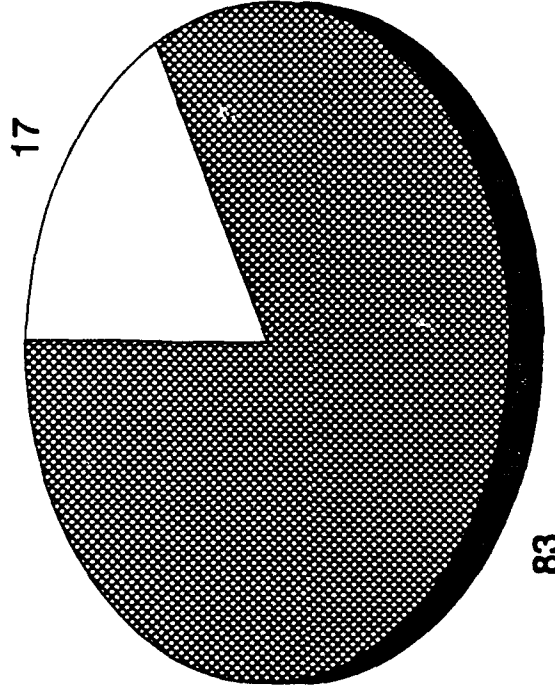
Industry



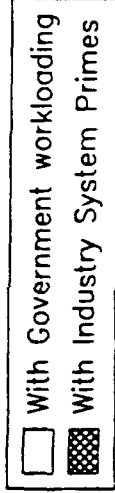
Small Business

GOCO Questions

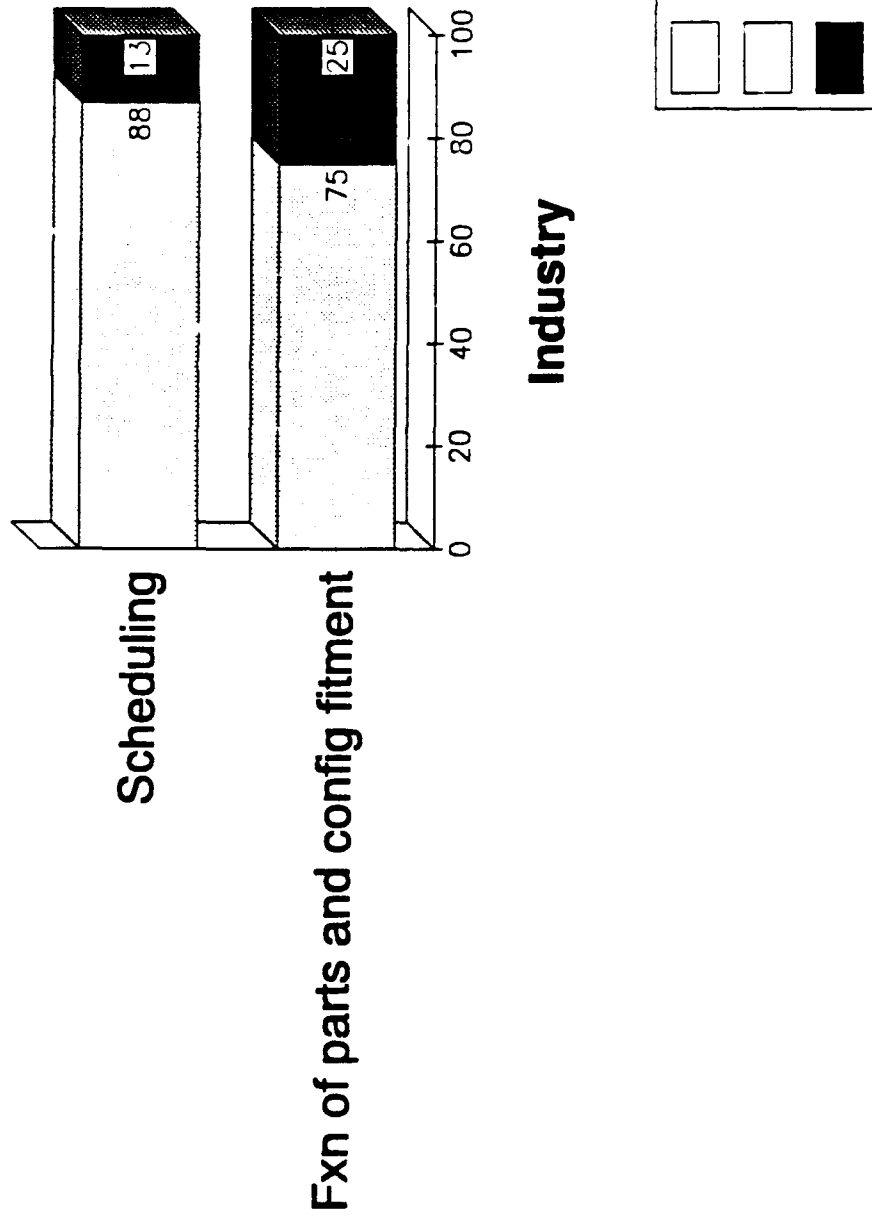
Preferred way to do "third party contracting"



Industry

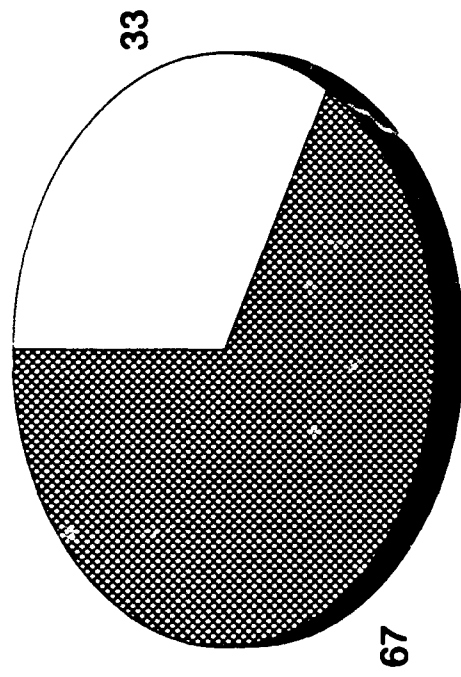


Which of the following instances do you find that your production process runs the most smoothly with respect to:

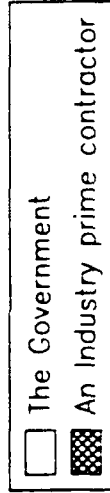


Small Business Question

What is preferred way to do "third party contracting."

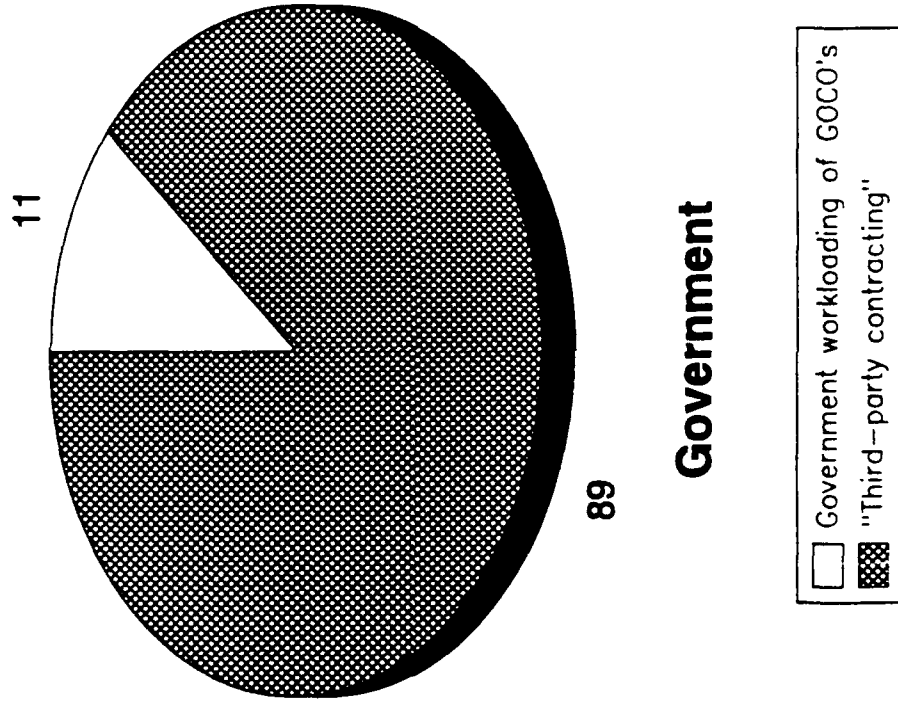


Small Business



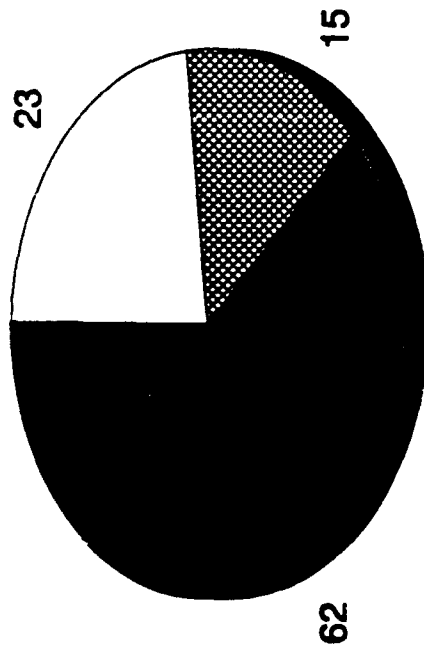
Government Question

With regard to the Army's GOCO system, which is more effective overall for the Government?

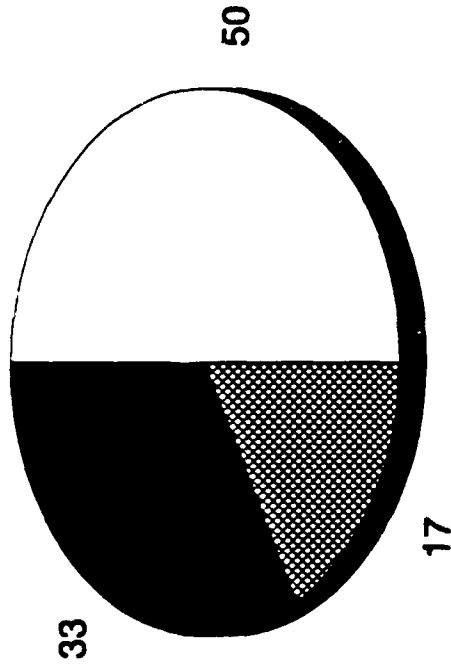


Demographic Questions

Company type.



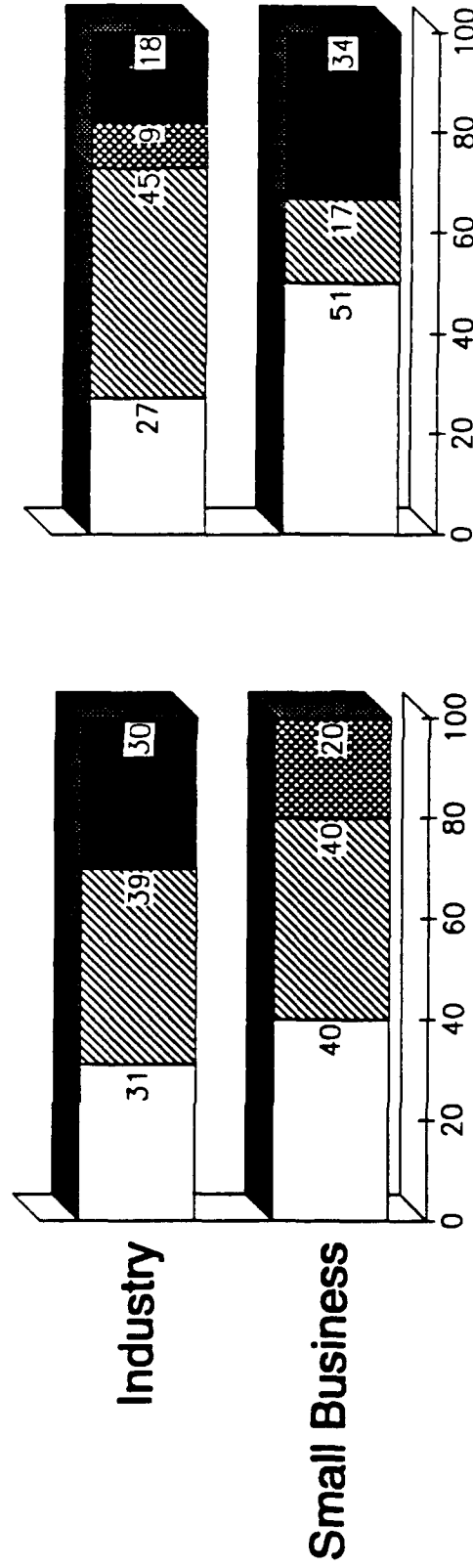
Industry



Small Business

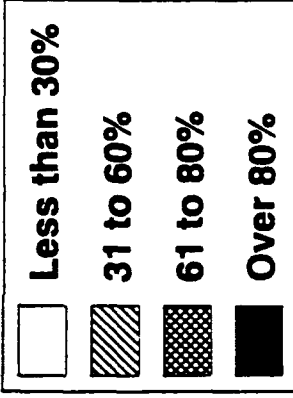
- ☐ Build-to-print
- ☒ Maintain own R&D technology base.
- ☒ "Full service" R&D and production for ammunition or missile systems.

Portion of sales base:

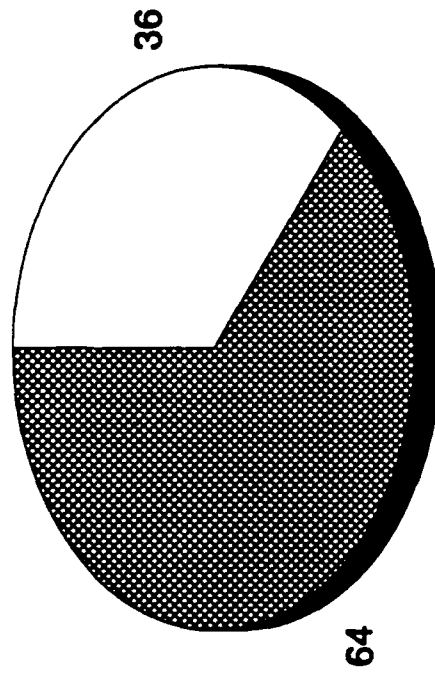


Government System Managed (or break-out)

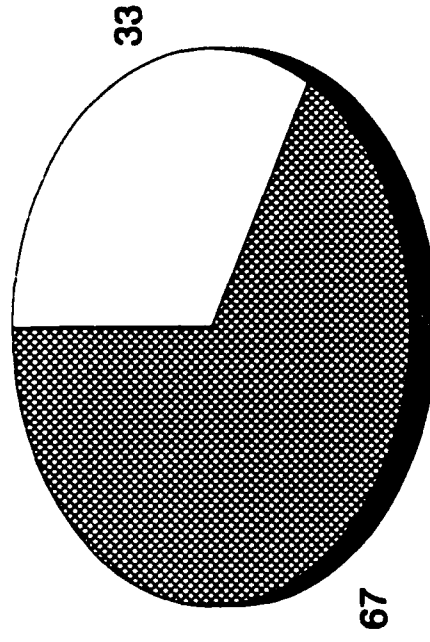
System contracting with industry



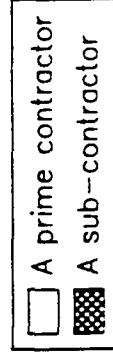
Portion of business between prime and sub-contractor.



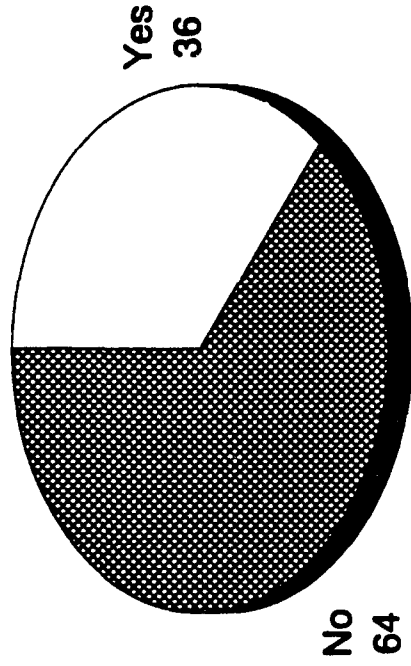
Industry



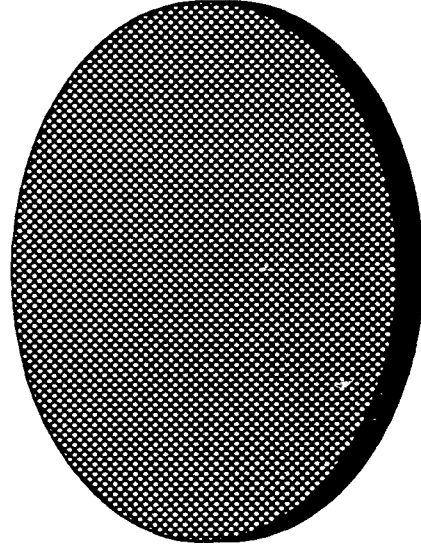
Small Business



Does your company maintain its own full round test facilities?

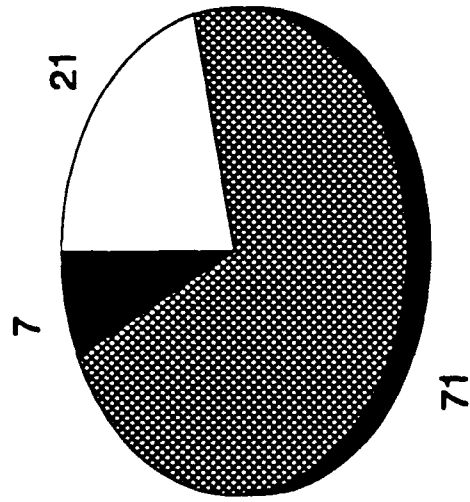


Industry

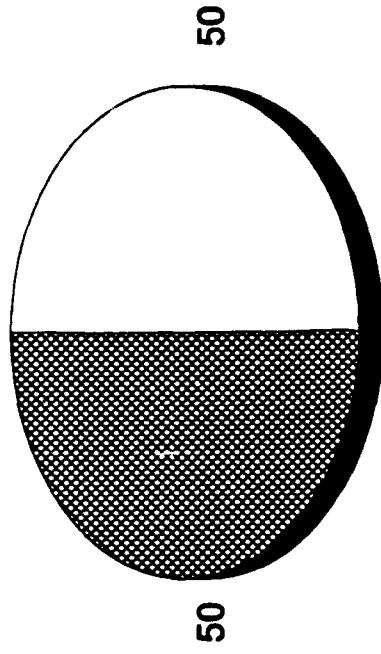


No 100
Small Business

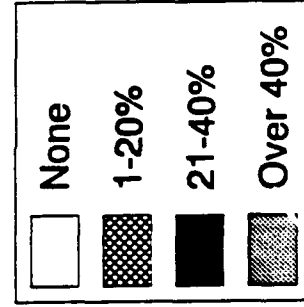
Portion of foreign sales base - direct "commercial sales".



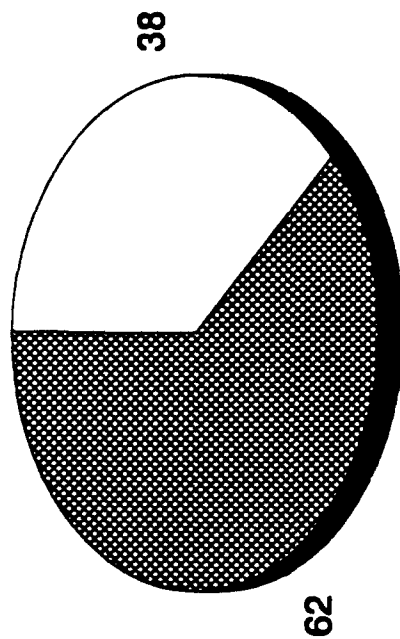
Industry



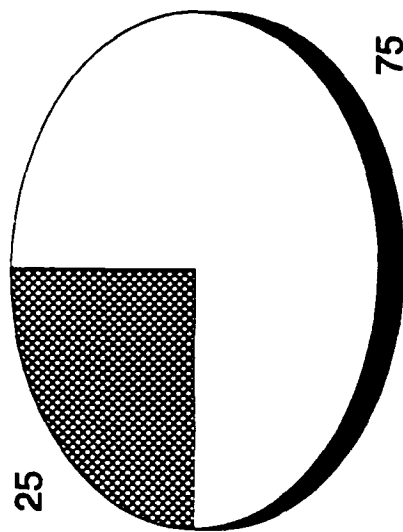
Small Business



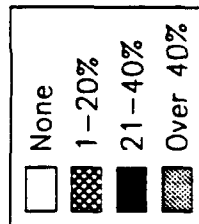
Portion of foreign sales base - FMS case marketed by your company.



Industry



Small Business



APPENDIX E
GOVERNMENT SOURCES AND INDUSTRY SOURCES SOLICITED
(There is no accurate list of actual identities of survey respondents)

GOVERNMENT SOURCES

DA

Dr. Jay Sculley – Former ASARDA
LTG Donald Pihl (USA-ASARDA, Ret)
COL(P) O. Mullen – ASARDA
George Dausman – ASARDA

OSD

George Kopscak – OSD-Munitions

AMC

Sy Lorber (Ret)
BG W. Schumacher
Darold Griffin

AMCCOM

George McCoy
Les Griffin
Perry Stewart
COL Glenn Phelps
Mrs. Jeanne Smith

INDUSTRY SOURCES

Systems Managers

General Dynamics
Valley Systems Division

Hughes Aircraft
Missile Systems Group

Martin Marietta Corp.
Ordnance Systems, Inc.

Gencorp Incorporated
Aerojet ElectroSystems Co.

Textron Defense Systems

McDonnell Douglas Missile Systems
Company

Olin Corporation
Defense Systems Group

ARDEC

D. Botticelli
Dr. T. Davidson
Dale Adams (PEO Armament)
George Batchis
Louis Artioli
Spencer Hirshman

MICOM

COL. Earl Finley – PM-AAWS

Other

Mr. John Byrd – Defense Ammunition
School
MG William Eicher (USA-AMCCOM,
Ret)

Howitzer Ammunition Suppliers

Chamberlain Mfg. Corp.

Day and Zimmerman

Mason & Hanger – Silas Mason Co. Inc.

Bulova Technologies, Inc.

Armtec

NI Industries
Norris Division

Thiokol Corp.
Ordnance Operations

**Other Large, Small, and Small
Disadvantaged Businesses**

Valentec Intl. Corp.

Piper Impact Inc.

Ion Electronics

Kurt Manufacturing

Accudyne/Astra Holdings

Ireco

Stresau Labs

Harley Davidson Inc.

Painted Feather

Dakota Tribal Industries

Lockley Manufacturing

Action Manufacturing Co.

Hercules Aerospace Company

Talley Defense Systems

BMY

Green Intl. West Inc.

Rexon Technology Corp.

ICI Americas, Inc.

Nuclear Metals, Inc.

CONCO, Inc.

Heckethorn Mfg. Co.

AMRON Corporation

AAI Corporation

AIMCO

BEI Defense Systems Co.

Defense Research Inc.

EMCO, Inc.

Balimoy Mfg. of Venice, Inc.

Lanson Industries Inc.

CIMA Machine & Tool Co., Inc.

Tracor Aerospace Inc.